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A REVIEW OF THE AVAILABLE LITERATURE ON THE PHARYNX AND PHARYNGEAL SURGERY FOR 1940.

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ANATOMY.

Schugt[1] first presents a brief anatomical review of the pyriform fossa, continuing with a statement of what may be seen in a clinical examination of the normal larynx. He states that anomalies of the pyriform sinus are rare but mentions projection of the upper cornu of the thyroid cartilage into the sinus, folds in the pyriform sinus due to retarded development and fracture of the hyoid bone protruding into the sinus as conditions not infrequently noted. The accessibility of the superior laryngeal nerve is good and in some cases where an injection of alcohol from the outside in the painful deglutition of tuberculosis is impossible, he is able to strike the nerve via the fossa. Mention is made of "the tonsil of the pyriform sinus," a bit of lymphoid tissue the size of a pea lying deep in the recessus pyriformis. This so-called "tonsil" has a typical lymphoid structure with a centrally located crypt lined with stratified squamous epithelium which also covers the upper surface. Wiethe, in 1931, described much the same pathology as shown in the palatine tonsil and has proven that it is possible for inflammatory reaction with peritonsillar edema to occur in this lymphoid tissue. He is of the opinion that this tissue can give rise to phlegmonous laryngeal processes. Using these findings as a basis, Schugt then conjectures as to the possibility of such an origin in the

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cases of laryngeal abscesses which do not have their development from a tonsillitis, pharyngitis or traumatic cause. In the diagnosis of abscess of the thyroid cartilage, it is important to remember that the floor of the pyriform sinus bulges upward, because the upper and posterior portions of the thyroid cartilage form an unyielding wall externally. Incision and drainage of such masses seem not to be always curative; therefore, the author likes to make an external approach through the thyroid cartilage. He recalls a case in which an internal approach was made, and, due to the severe swelling and distortion of the landmarks, the superior laryngeal vessels were cut, with a near fatal hemorrhage before ligation of the carotid artery could be done. The anatomy of the pyriform sinus in relation to the posterior pharyngeal wall and the related prevertebral fascia and lymphatics is well known and forms an easy avenue for inflammation to travel into the mediastinum. This can happen in four ways: *1.* Pus can spread from the pyriform sinus along the posterior surface of the thyroid cartilage and by breaking through the cricothyroid ligament reach laterally to the great vessels of the neck and thence to the mediastinum; *2.* pus can pass around the posterior edges of the thyroid cartilage into the region of the great vessels; *3.* pus lying in the pyriform sinus can break through the thyroid cartilage anteriorly without being palpable or visible, then burrow downward to the mediastinum; *4.* pus can pass from the pyriform sinus into the neighboring spatium paravertebral and thence directly to the posterior mediastinum. The pyriform sinus is also a channel for the lymphatics of the hypopharynx, upper larynx and part of the base of the tongue. The lymph vessels run beneath the mucous membrane of the sinus and pass through the thyrohyoid membrane alongside the superior laryngeal artery, to reach the deep cervical glands. On the way to these glands they sometimes pass through a row of small lymphoid nodules which lies next to the thyrohyoid membrane. When these nodules are present they lie either in front of or below the hyoid bone, or at times below the muscles radiating from the bone. These glands therefore may be significant in tumors or inflammations of the higher-lying parts (hypopharynx, upper larynx and base of the tongue). In 1904, von Eicken described a condition called "frothing in the pyriform sinus," observed in cases of diverticulum of the esophagus. In America this

is called Jackson's sign. This sign is also observed in aortic aneurysm, substernal thyroid, esophageal tumor, esophageal varix and bulbar paralysis. In the author's experience this sign is a valuable indication that there is a disturbance in swallowing. Concerning the methods of examination of the pyriform sinus, the author states that by all means a direct examination should be done following the usual mirror inspection in cases where malignancy is expected.

As a result of the autopsy findings in a case of suppuration of the petrous pyramid which ruptured into the nasopharynx, and of Guild's article, "The Normal and Pathological Anatomy of the Petrous Pyramid," Burke[2] considers the nasopharyngeal approach to such suppurations. Inferiorly the petrous pyramid is very near to the lateral part of the vault of the pharynx; and the levator palati and tensor veli palatini originate in part from the undersurface of the pyramid. Several procedures of exploring the pyramid are described.

PHYSIOLOGY.

McCarrell[3] describes a preparation which produces a constant cervical lymph flow in the anesthetized dog. Certain critical temperatures at which cervical lymph flow is altered were determined in a series of eight dogs. The dogs were anesthetized and the right and the left cervical lymph vessels were cannulated. The snout of the dog was attached to an electrically driven crank which, as it rotated slowly, insured a constant flow of lymph without the use of massage. The lymph flow from the two cervical vessels was collected, pooled, weighed and the flow calculated in milligrams per minute. Nasopharyngeal irrigation with normal saline at 37° C. had no effect on cervical flow or its protein concentration. When the temperature reached 50° C. or above, the lymph flow increased tremendously. The lymph was also highly proteinized. Microscopic sections of the mucosa showed evidences of tissue damage, as well as hyperemia and swollen lymphatics. Reducing the temperature of the irrigating fluid below 37° C. caused no marked changes until a temperature of 5° C. was reached. At this point, after a latent period of 10 to 15 minutes, the flow became definitely greater. There was no change in the percentage of the protein. A second irrigation with cold saline caused a more sus-

tained increase in lymph flow, with a rise in the percentage of protein. Histological examination of the nasopharyngeal mucosa showed a hyperemia as well as epithelial damage in some regions.

DIAGNOSIS OF NASOPHARYNGEAL DISEASE.

Hill[4] acknowledges that the nasopharynx, like the larynx, is not readily accessible to visual examination and as a consequence is not always accorded the thorough inspection necessary for correct diagnosis. The postnasal mirror, Yankauer speculum, the nasopharyngoscope, digital palpation and Roentgenograms are all important aids in the examination of this region. Direct inspection of the nasopharynx by elevation of the soft palate is the most accurate and valuable method of examination. Too often one is satisfied that a mass in the nasopharynx is normal adenoid tissue. Choanal polypi, nasopharyngeal fibroma, cysts or malignant tumors may be the cause of such a mass. Suppuration of the petrous apex may point in the nasopharynx. With these possibilities in mind, the pitfalls of incorrect interpretation need not loom so large.

MISCELLANEOUS DISEASES OF THE NASOPHARYNX.

Swinburne[5] describes keratosis pharyngis as an affection of the epithelium associated with the lymphoid tissue of Waldeyer's ring. It rarely affects the lymphoid tissue in the larynx. It is characterized by yellowish-white outgrowths seen usually as hornlike projections, and less commonly as plaques. Usually there are no symptoms other than pricking or tickling sensations. The first case was reported by B. Frankel in 1873. In 1884, Heryng wrote on the subject and stated it was caused by a leptothrix. He suggested the name of pharyngomycosis leptothrica. The etiology is unknown but it is probably associated with chronic inflammation. It is usually found in the crypts of the faucial tonsil and at the base of the tongue, but it can occur at any point in Waldeyer's ring. It occurs only on exposed parts, develops slowly and seems to follow an inflammatory process. If strong irritating applications are used, it may prolong the condition. Before disappearing, the horny outgrowths become softer and more loosely attached. They then decrease in size

and finally disappear completely. Recurrences are rare. At first glance the condition appears to be a follicular tonsillitis but careful examination shows absence of local inflammation and the presence of the horny, discrete projections of epithelium. Treatment is of little value; if the condition worries the patient, the tonsils may be removed, and sinusitis if present should be treated so as to remove the causes of chronic irritation.

In 1925, Brill, Baehr and Rosenthal called attention to a disease characterized by a general lymphadenopathy in which there occurs a characteristic hyperplasia and hypertrophy of the lymph follicles without specific changes in the blood, and with or without enlargement of the spleen. Until Novak[6] presented his case, all reports had dealt with the cervical, inguinal, mesenteric or other nodes but none involved the terminal nodes, such as the tonsil or the adenoid. His case is that of a man, age 50 years, who complained of marked loss of hearing. A large mass was found in the nasopharynx. otherwise the general physical examination, chest plate and blood count were normal. The mass was removed surgically to relieve the tubal occlusion. Microscopic examination revealed a great increase in the number and the size of the follicles.

TREATMENT IN DISEASES OF THE PHARYNX.

Richards[7] calls attention to the necessity of systemic treatment in simple follicular tonsillitis. This mainly concerns the comfort of the patient and satisfactory diet. The efficacy of gargles is doubted because of the small contact of the solution with the inflamed areas. External applications of heat seem more rational, while anesthetic lozenges also afford relief. He, as well as Hughes,[8] is convinced that the sulfonamides are not indicated in uncomplicated cases. Vincent's angina is treated by Richards in the conventional manner. Oxygen-liberating solutions and chromic acid applications are recommended. He feels that arsenicals may be employed.

Fox and Wigglesworth[9] report on 55 cases of tuberculous pharyngitis and laryngitis treated by topical application of cod liver oil as recommended by Banyai. The method consists of spraying plain U.S.P. cod liver oil over the diseased areas

three times a day, about an hour after each meal. Of the 55 cases, 40 were laryngeal and 15 pharyngeal. Only two cases were purely pharyngeal. Special attention was given to the appearance of the lesion, change in the voice, character of the cough, severity of pain, dysphagia and weight curve. The results compared favorably with those of Banyai. Ulcerations responded very well. In cases where the pain was intense, the oil appeared to have a definite analgesic effect. It is believed that the action is largely mechanical.

RETROPHARYNGEAL ABSCESS.

Iglauer[10] finds retropharyngeal abscess described as a collection of pus in the areolar tissue behind the pharynx. But if one examines this area he finds it continuous with the space behind the esophagus, and the question arises, why does not the retropharyngeal abscess gravitate to the posterior mediastinum instead of remaining localized higher up? The usual answer is that since the abscess begins as a suppurative lymphadenitis, inflammatory adhesions form about its periphery and prevent downward extension. Contrary to the classical subdivision of the cervical fasciae into three separate layers, Weintraub, in 1932, was able to show by careful dissection of the neck that the space behind the pharynx, usually called the "retropharyngeal space," is not a single space but three separate compartments. There is an extensive median compartment, called the postvisceral space, and also a pair of symmetrically placed juxtamedian closed pharyngeal spaces. A fully developed retropharyngeal abscess is usually palpated through the posterolateral wall of the pharynx to one side of the median plane. Above, it may extend behind the choanae, while inferiorly it may extend to the cricoid cartilage. This area coincides exactly with one of the peripharyngeal spaces mentioned above because superiorly the space terminates at the upper border of the superior constrictor muscle. Inferiorly, it extends to the level of the lower border of the cricoid cartilage. Laterally, the space is limited by the neurovascular fascial bundle. Medially, the space is limited by a fibrous septum which separates it from its partner of the opposite side. These peripharyngeal spaces are "mural" and separate from the "extramural" postvisceral space which extends from the anterior arch of the atlas to

the posterior mediastinum as far as the diaphragm. The postvisceral space in the neck is limited by the neurovascular fascial bundles laterally but separated from the peripharyngeal spaces at that point. Therefore, it is evident that the peripharyngeal space could form the anatomic site or pocket for a closed retropharyngeal abscess. If suppuration occurs in one of these closed spaces, localization and the failure to spread into the posterior mediastinum or into the adjacent parapharyngeal space is explained.

Grodinsky[11] considers that retropharyngeal infections may involve the space between the pharyngeal wall and the visceral fascia; the space between the visceral fascia and the alar fascia; or that space between the alar and the prevertebral fasciae. An infection of the retropharyngeal region may, therefore, remain localized to the visceral space or it may extend to the other spaces mentioned; furthermore, it may migrate to the superior mediastinum, the posterior mediastinum or to the lateral pharyngeal space. Lateral pharyngeal abscess, originating as such, may likewise spread to the retropharyngeal area. Acute abscesses in these locations are more often seen in young children, and they are usually secondary to infections of the nose, throat or ear. They reach these areas by direct continuity or lymphatic drainage. Iglauer[10] thinks it is probable that simple retropharyngeal abscesses result from the breaking down of infected lateral retropharyngeal lymph nodes. These nodes lie just beyond the upper, outer limit of the peripharyngeal space in the interval between it and the internal carotid artery. The glands are not free in the space but adhere to its thin wall. They drain the nasopharynx, including the adenoid, the fossa of Rosenmüller, the Eustachian tube, the middle ear and the nasal cavities. Infection in one of these glands points downward, medianward and forward along an attached vulnerable fat chain toward or into the peripharyngeal space. It enters this space rather than the postvisceral space because the latter is more medial and terminates above in a blind pouch at a lower level than the apex of the peripharyngeal space. Grodinsky says that the clinical picture of mild or severe infection of the ear, nose or throat, followed by pain, dysphagia, chills and fever, with signs of internal bulging of the pharyngeal wall, should furnish a clue as to the possible course of events. Extension of

the process to the mediastinal spaces is indicated by chest pain, dyspnea, persistent fever and Roentgenographic evidence of mediastinitis.

Smith[12] reports a series of cases with an abnormally large percentage of adults. He states that in the adult there is no difference in the pathology, treatment or complications, but that tuberculosis and foreign bodies are much more common etiological factors in children. In adults the signs and symptoms all point to the cervical region; while in the child who does not complain so quickly, the symptoms may lead far astray. The diagnosis is made largely on the history, signs, symptoms, inspection with the mirror, palpation, X-ray examination and the exploratory needle if need be. Rhodes[13] states that severe and fatal hemorrhages resulting from retropharyngeal infections are relatively rare and for that reason the attending physician is often bewildered when he is confronted with such a situation. These hemorrhages are the result of secondary involvement and erosion of the blood vessels traversing the infected area. The branches of the common carotid artery and the internal jugular vein lie in these spaces. The veins usually react by thrombosis of their lumina; but the arterial walls are too thick and the blood flows too fast for thrombosis to occur. There may be direct infiltration through the arterial wall with resultant rupture. With the first leakage of blood there is usually an increased swelling of the neck and retropharyngeal region. Within a few days the pressure of the infected blood ruptures through a small opening in the pharyngeal mucous membrane, giving the first warning of approaching danger. The opening gradually becomes larger, allowing pressure in the space to become decreased, and finally results in a severe or fatal hemorrhage. The vessels that are eroded in these cases are the internal carotid, common carotid, and the external carotid or its branches. When one of these vessels is involved, the only rational treatment is ligation of the artery involved proximal to the source of hemorrhage. Any patient with retropharyngeal infection presenting the complications of slight bleeding from the pharynx should have prompt ligation of the carotid artery before the inevitable exsanguinating hemorrhage occurs. The vessel should be doubly ligated and severed between the ligatures. The main branches of the vessel

should also be ligated to prevent the development of a collateral circulation. Three possible sites for ligation have been described, all of which have some arguments against them: *1.* Primary ligation of the common carotid artery alone. This has proved inadequate because of the abundant collateral circulation beween the external and the internal branches at the site of bifurcation of the common carotid artery. *2.* Ligation of the internal carotid artery alone. Although this is the vessel most often involved, its ligation is not adequate, since one of the other vessels may be responsible for the bleeding. *3.* Ligation of the external carotid artery alone. Here again, the procedure is inadequate, for the reason given above and also because the collateral circulation from the opposite side may re-establish the hemorrhage. As an all-inclusive measure, it is suggested that ligation of the common carotid artery, the external carotid and its major branches be performed. This procedure is a prophylactic measure at the original operation. It assures control of bleeding, whatever the source, and at the same time eliminates the possibility of recurrent hemorrhages through collateral circulation from the opposite side. As a conservative concession to this radical measure, the author suggests: *1.* Excision of the external carotid by ligation of all of its branches; *2.* a heavy silk ligature placed about the internal carotid, with its ends brought out through the wound, this ligature to be immediately tied if further bleeding occurs. There is no disagreement that the treatment in retropharyngeal abscess is prompt incision and drainage, usually via an intraoral incision; but occasionally an external approach is indicated, especially when the infection is of tuberculous origin.

PERITONSILLAR ABSCESS.

Tonsillectomy as a radical attack in peritonsillar abscess is recommended by Brighton[14] when there is no improvement following simple incision. General anesthesia is used and the postoperative course is generally satisfactory. Blashki[15] likewise recommends tonsillectomy-a-chaud in quinsy when it occurs with severe trismus, in retrotonsillar hemorrhages following incision, in partially removed tonsil or when laryngeal edema develops. He feels that the theoretical objections to operation are not supported by experience and considers it a safe procedure when performed under proper conditions.

Youngerman[16] points out that in the adult, diphtheria is often associated with peritonsillar edema and, therefore, very likely to be mistaken for peritonsillar abscess. The tendency to incise this swelling is great but this is a grave mistake, followed by a high mortality. Should incision in such a swelling not be followed by evacuation of pus, immediate administration of antitoxin is recommended. Because of the descending nature of the infection, early low tracheotomy should be performed if respiratory obstruction develops. Rarely is incision of a peritonsillar abscess so urgent that it cannot be delayed until a culture has been obtained.

SEPSIS FOLLOWING PHARYNGEAL INFECTIONS.

Hall[17] discusses general sepsis originating in the pharynx or the pharyngomaxillary space. He states that severe sepsis is not an uncommon complication or sequel of pharyngeal infections, the true nature of which is too frequently recognized only at postmortem. When one is confronted by such a case, a careful history and a knowledge of the anatomy and pathology of this region are essential for its proper management. There are three routes by which infection may reach the general circulation from the pharynx: *1.* the phlebitic; *2.* the phlegmonous; and *3.* the lymphatic. Either one, or a combination of them, may be operative in an individual case. A thrombophlebitic process arising in the small veins of the pharynx reaches the general circulation through the common facial veins flowing into the internal jugular. Some of the smaller pharyngeal veins, together with the anterior and the posterior facial veins, may occasionally enter the jugular vein independently. When the jugular is once involved, there may occur retrograde involvement of the lateral sinus. In the phlegmonous route, the main consideration is the pharyngomaxillary space. Infection there may cause involvement of the internal jugular vein by periphlebitis or thrombophlebitis. The signs of pharyngomaxillary phlegmon are extreme trismus, induration and swelling over the parotid gland, obliteration of the subangular space beneath the angle of the jaw and peritonsillar swelling and induration with little or no pharyngeal inflammation. The author frankly admits he has had very little experience with infections caused by the lymphatic route. General sepsis may follow the pharyngeal

infection immediately, or may not appear for several days or several weeks after its subsidence. In the phlegmonous type involving the peritonsillar or pharyngomaxillary space, the diagnosis should present no difficulty; however, in the purely phlebitic type, the pharyngeal symptoms are frequently so slight as to cause the fatal overlooking of the source of the sepsis. In the presence of severe sepsis, when there is a history of recent pharyngeal infection, surgical investigation is urgent. The primary requisites of treatment are the control of the primary focus, cutting off of the primary focus from the general circulation and the prevention of metastatic foci. To control the primary focus, it is necessary to afford surgical drainage or to institute chemotherapy. To cut off the primary focus from the general circulation, the common facial vein, the internal jugular vein, or both, must be ligated. To combat metastatic foci, chemotherapy and general supportive measures must be relied upon. A pharyngomaxillary phlegmon not responding to chemotherapy in 48 hours and accompanied by sepsis should have external drainage and possibly venous ligation.

PHARYNGEAL DIVERTICULUM.

Harrington[18] reminds us that diverticula may occur in almost any part of the esophagus. They are divided into two main groups, the pulsion and the traction types. Traction diverticula usually occur in the median and lower third of the esophagus, and only rarely do they give rise to symptoms. Pulsion diverticula are most commonly situated in the hypopharynx, near the pharyngoesophageal junction, and usually the symptoms of this type are referable to the esophagus. Pulsion diverticula are the more common in the pharynx. They are usually located on the posterior wall just to the left of some muscular deficiency between the inferior constrictor and the cricopharyngeus. They actually represent herniations of the mucous and submucous coats of the pharynx, which may possibly be due to a congenital defect, to neuromuscular incoordination during swallowing, to increased pressure on the posterior part of the pharynx, or to areas of muscular deficiency at the point of entrance of nerves and vessels through the posterior pharyngeal wall. It is most probable that muscular deficiency is the predisposing cause and that the other factors act as the inciting cause. The clinical

manifestations in 225 cases of pharyngeal diverticulum were reviewed. In 85 per cent they were vague and indefinite at the onset. Marked symptoms required one to 18 years to develop. In the remaining 15 per cent of the cases, the symptoms were more rapid in their progress and severity. The difference in the progress of early symptoms seems to be related more to the character of the neck than to the size of the sac. In many cases it was found that relatively small diverticula with small openings produced most disabling symptoms, while large diverticula with large openings produced little disability because of the ease with which the sac could be emptied; however, in both types it was found that the larger the diverticulum the greater the severity of the symptoms, esophageal obstruction being not uncommon. Dysphagia is the earliest symptom. The patient complains of the sensation of a foreign body and that food sticks in his throat. Later, there are regurgitation of food and mucus, noisy deglutition and a sensation of fullness in the throat. The relative merits of the one-stage and the two-stage operations are discussed and there are reports on a series of cases done by both methods. In properly selected cases, the one-stage operation is preferred. The fundamental difference between the two operations is that in the one-stage procedure, the fascial planes leading into the mediastinum are not walled off preliminary to the removal of the diverticulum. The method of approach in both methods is the same: from the side of the neck on which the diverticulum is located, usually the left. Shepard[19] advocates passing of a "string-guide" as a safe means of dilatation and describes his procedure in cases of diverticulum. He further describes a special technique developed for the correction of these diverticula. An angled clamp is applied to the neck of the diverticulum distal to two guy-sutures previously place. The sac is removed with the cautery and the edges inverted by means of the sutures. Del Valle, Yodice and Gebauer[20] report two interesting cases of diverticulum of the pharyngoesophagus. The first was that of a female, age 70 years, with a large diverticulum, causing marked dysphagia with a loss of 55 pounds in weight. Operation was performed in two stages. The second was that of a woman, age 72 years, who was admitted with a history of dysphagia and regurgitation for six months. Roentgenographic studies revealed a small diverticulum of the esophagus. Esophagoscopy was followed by subcutaneous emphy-

sema. A low grade fever persisted for six days. The patient was discharged, but returned 13 days later with the history that 10 days following esophagoscopy she gagged and vomited old blood and foul, yellow mucus. Roentgenograms revealed a perforation of the diverticulum with a tract in the mediastinum leading to a large abscess above the fascial attachments to the pericardium. A posterior mediastinotomy was done and an abscess containing 300 cc. of foul pus was drained. A drainage tube was left in place because barium when swallowed could be demonstrated coming from the perforated diverticulum into the mediastinum through a string-like tract. Later, the diverticulum was excised and the stump inverted, following which the patient made an excellent recovery.

ROENTGENOGRAPHIC EXAMINATION OF THE PHARYNX.

Roentgenographic studies of the processes of deglutition are contributed by Welin.[21] The classical description of deglutition dates from Magendie in 1817. By 1850 it was stated by Hyrtl that during swallowing, the epiglottis acted as a trap door over the ostium laryngis, thereby serving as a bridge for the food. In 1892, Anderson-Stewart asserted that the epiglottis remained upright at all times, the food gliding over its surface. In 1911, M. Scheier showed that the earlier view of Hyrtl was correct. Since then most workers have arrived at the same view. Among those who contend that the epiglottis remains upright during the whole act of swallowing are Negus, Barclay and Thunberg. Through the use of the X-ray, it is possible to study deglutition better than ever before. It may be noted that, first, the opaque medium is carried voluntarily to the base of the tongue and pharynx. There voluntary movements cease and the swallowing reflex is called into action. The larynx and hyoid bone are lifted upward and, to some extent, forward. At the same time, three of the four possible routes for the food are closed, *viz.: 1.* the oropharyngeal opening — by the tensing and closing of the anterior pillars; *2.* the passage to the nasopharynx — by closure of the posterior pillars and the formation of a transverse ridge on the posterior and lateral walls of the pharynx; *3.* the passage to the larynx — by closure of its entrance. It is easily noted that the epiglottis bends from a vertical position to a horizontal one as soon as the contrast

medium touches it. It remains so until all of the material has passed, then it snaps back into its normal upright position. Five cases with an abnormal swallowing mechanism are presented. The patients had all reached the cancer age and complained of such well marked sensations of foreign body and difficulty in swallowing that clinicians suspected cancer of the hypopharynx or esophagus. No evidence of malignancy could be found by X-ray or direct inspection. Plummer-Vinson disease, botulism, poliomyelitis, myasthenia gravis and bulbar paralysis were ruled out. It was discovered that all of these patients had an abnormal deglutitory act. The epiglottis returned to its normal position following swallowing only with the greatest difficulty. During the upward movement, the epiglottis became more angularly bent than normal, while the sagittal diameter of the pharynx at the same time seemed smaller than normal. The epiglottis did not appear longer than normal. It was thought that the trouble might be due to local changes in the epiglottis, such as diminished elasticity, or to some nervous disorder, with the result that the larynx was either not drawn sufficiently forward or that it resumed its initial position too quickly. Shannon and Veitch[22] discuss the Roentgenographic investigation of the pharynx, esophagus and larynx and the diseases which produce so-called "upper dysphagia." With skillful exposure and interpretation of the film, every region of the pharynx and larynx are seen to have numerous observable landmarks. In the examination of these regions, the authors advocate the use of lateral films of the neck made with the larynx at rest, during the act of swallowing a nonopaque fluid, during the phonation of a high-pitched note, and during the act of swallowing a barium mixture. Recently, they have also employed the inflation method, in which the patient raises his own intrapharyngeal pressure by pinching his nostrils while making a gentle effort to blow the nose. This procedure widens the hypopharynx considerably. There follows a discussion of dilatation of the esophagus, stenosis of the esophagus, foreign bodies, neuropathic disorders, inflammatory processes and malignant conditions.

CHOANAL ATRESIA.

Morganstern[23] reminds us that congenital atresia of the postnasal orifices is due to the failure of normally occurring

embryonic structures to disappear. The theories of its formation ascribe it to: *1.* the persistence of the bucconasal membrane; *2.* the persistence of the buccopharyngeal membrane; and *3.* the overgrowth of the horizontal and the vertical processes of the maxillae. While unilateral choanal atresia is rare, congenital bilateral occlusion is even more rarely reported because it often results in death from asphyxia at birth and thus remains unrecognized. He advocates the use of electrocoagulation because of its accuracy and simplicity of application. He reports a case successfully operated upon by this method and strongly advocates it as the method of choice. Cinelli[24] finds that 220 cases have been reported to date, the majority occurring in the past 20 years. He states that diagnosis is a relatively simple problem but treatment is more difficult. In the unilateral type of atresia, operation may not be necessary. The type of operation is governed by the nature of the atresia. If it is osseous, a mere perforation is all that is necessary. This may be grafted by Blair's technique for best results. The field should be absolutely dry before applying the skin graft and the graft should be completely immobilized, otherwise it is certain to slough. It is also important not to injure the mucosa of the nasopharynx. In the membranous form of choanal atresia, good results are obtained by surgically removing a large portion of the obstruction and the posterior third of the septum, and using electrocoagulation for future granulations. There is a scarcity of material in the literature on atresia of the nasopharynx Wright and Smith collected 69 cases and advocated the use of monochloracetic acid on the raw surface after division of the atresia. Congenital types are very rare. Acquired types are usually due to syphilis, trauma, diphtheria and tuberculosis. The symptoms are difficulty of nasal breathing, obstruction of the Eustachian tubes with loss of hearing, nasal tone to the voice, profuse purulent secretion from the nose, and some loss of smell and taste. The congenital membrane can easily be divided with the finger, and the raw surface painted with monochloracetic acid, which will keep it open. The acquired form presents the problem of retaining patency. The outcome depends upon the nature of the pathology and the extent of the involvement. If the case is not luetic, the prognosis is good. MacKenty's operation is the one of choice. It is based on the principle of Nichols that the defect has its

origin in a tendency of wounds to heal from their periphery towards the center. Goodyear[25] reports a case of membranous atresia of the nasopharynx following scarlet fever. He was able at the time of the operation to produce a flap of mucous membrane, which was placed against an unbroken surface of the posterior pharyngeal wall. The result has been excellent. Mangiaracina[26] reports a case of congenital atresia of the posterior nares successfully operated upon by means of a posterior submucous resection, followed by excision of a fibrous obstruction.

LYMPHOID TISSUE IN THE NASOPHARYNX.

Crowe[27] emphasizes the importance of lymphoid tissue in the nasopharynx. Primary infection in this tissue may extend to the sinuses, ears, larynx, bronchi and lungs. During the past 14 years, radon applications by means of a nasal applicator have been used in reducing the size of adenoids as an adjunct in the treatment of mouth-breathing, recurring attacks of nasopharyngitis, impaired hearing due to tubotympanic catarrh, suppurating ears, accessory nasal sinus infection and asthmatic bronchitis. Radium does not supplant surgery but it is much more effective than sprays, drops or local applications. Upper respiratory infections, especially in children, result in hypertrophy and hyperplasia of lymphoid tissue. Even if all such children have their tonsils and adenoids removed, the result is not always satisfactory, due to the impossibility of removing all of the lymphoid tissue present. As proof of this, 5 per cent of a group of 755 school children who had had tonsil and adenoid operations showed a marked recurrence of adenoid tissue in the nasopharynx even though the indications were that the operations had been properly performed. Crowe feels that in such cases the proper treatment is radiation rather than reoperation. If this tissue is not removed, the ears are most likely to suffer and, because of this, he suggests that otolaryngologists examine the nasopharynx, the tympanic membrane and the hearing of children once or twice a year as a matter of prophylaxis. The first evidence of hearing loss is detected in the higher frequencies — above the range of most clinical audiometers. If progress of the deafness results, one tone after another is involved until the speech range (250 to 3,500 d.v.) is reached.

It is not the size but the location of the lymphoid tissue that is important. Tissues located in and around the tubal orifices obstruct the tubes and, unfortunately, cannot be removed surgically without further damaging the tubes. If such a situation is encountered, the patient should be watched and at the first sign of impaired hearing for high tones the nasopharynx should be irradiated. Repeated audiometric and nasopharyngeal examinations must be made and radiation treatments repeated at intervals of a month, until the orifice of the tube can be clearly seen. While X-rays may be used to remove the obstructing masses of lymphoid tissue, there are disadvantages to this method, and radon applications are much simpler and safer.

Polvogt[28] in a less detailed article has largely the same comments to make regarding adenoid hypertrophies. He points out that the safety and success of radiation in this condition is based on the observation of Heineke that lymphoid tissue is more susceptible to the rays than the adjacent epithelial tissue. A description of the radium applicator and the dosage employed concludes his publication.

TUMORS OF THE NASOPHARYNX – BENIGN.

Swinburne[29] presents the case of a female patient, age 59 years, who for 20 years had noticed an oval mass in the nasopharynx. Two weeks prior to admission, it had increased in size, causing difficulty in breathing. Examination revealed a rounded mass projecting below the soft palate behind the left faucial pillar, extending upward, almost completely filling the nasopharynx. and attached to the left side of its posterolateral wall. It was translucent and freely movable. At operation a cyst was dissected from the wall of the pharynx, and the pedicle, located below the Eustachian tube, was snared off. The pedicle was composed of mucous membrane and submucous fibrous tissue. The author discusses the points for and against the branchial origin of the tumor and concludes that it must have been a simple cyst.

Lipomas of and adjacent to the pharynx are observed very infrequently. They are usually grouped broadly as pharyngeal growths which include nasopharyngeal, retropharyngeal, hypopharyngeal and extralaryngeal tumors, together with

those arising from the appendages of the pharynx. Retropharyngeal lipomas originate outside of the pharyngeal cavity and mucous membrane and should therefore be classified under separate headings from true pharyngeal tumors. Only 15 cases are reported in the literature. Putney and Fry[30] add two in which the tumor mass was situated between the pharynx and the vertebral column. Retropharyngeal lipomas produce symptoms only when they grow sufficiently large to cause obstruction to respiration, or deglutition. Differentiation from retropharyngeal abscess and malignant tumors can usually be accomplished without incision or biopsy. Treatment consists of surgical removal through an external neck incision. Care must be taken to keep the airway patent during the operation, and this can be done by intratracheal intubation before beginning the anesthetic.

Mixed tumors of the salivary gland type, according to Fox,[31] are benign tumors entirely separated from the salivary glands and probably originating from embryonic cells which have become detached from the body of the gland. They are firm, slightly nodular, completely encapsulated, do not break down and cause little local reaction and discomfort. They are usually found in the tonsillar and palatine area, where they develop gradually until they occupy a large portion of the pharyngeal space. They are easily diagnosed from their appearance and behavior, so that biopsy is unnecessary; furthermore, the microscopic structures are varied and complex. Inspection reveals externally a fullness or swelling of the neck below the lower jaw and the mastoid process, over the adjacent surface of the mandible and over the parotid region anterior to the ear. There is no inflammation of the skin and it is not adherent to the tumor. The pharynx shows a smooth medial bulging of the lateral pharyngeal wall, producing the impression that the tonsil has become enlarged. The soft palate is invaded and bulges downward and medially so that soon there is no distinction between the pharyngeal wall and the soft palate. The nasopharyngoscope is satisfactory in observing the increasing medial bulge of the lateral wall of the nasopharynx and the upward prominence of the soft palate. Digital palpation in the early stages shows the prominence of the tonsillar tissue, which seems to rest against a firm base without being a part of it. Later the tonsil is pushed backward and downward so that it is not easily palpated. One

finger in the pharynx and the other hand on the neck discloses a tumor which can be moved in small excursions from side to side. Irradiation has no beneficial effect and it complicates surgical removal by the resulting scar-tissue formation. The most satisfactory treatment is complete surgical removal of the growth with its capsule intact, through an intrapharyngeal incision. This procedure leaves no more distortion than many tonsillectomies, and no alteration of pharyngeal function. It avoids a large incision in the skin and the danger of working through important neck structures. Ligation of the external carotid facilitates the operation by reducing the amount of hemorrhage.

Figi[32] considers juvenile fibromas of the nasopharynx as the most interesting group of neoplasms encountered in the upper respiratory tract. They are characterized by their definite predilection for age and sex, their limited and comparatively inaccessible site of origin, extreme vascularity and tendency toward spontaneous regression. While they are benign, they have serious potentialities. Even though a large number of cases purporting to be juvenile fibromas of the nasopharynx have been reported by Shakeen, they are actually very rare, and many of the above-mentioned cases, by virtue of their description, must be considered as belonging to some other classification. They appear at about the age of puberty and continue as active neoplasms until the age of 20 to 25 years, when they tend to regress spontaneously. They may arise from almost any portion of the upper nasopharynx but are usually found in the vault. In their growth they are not confined to the limits of their origin but may extend into the pharyngomaxillary fossa, the sphenoid sinus, orbit, nasal cavity or downward into the pharynx. These fibromas usually appear as hard, often almost cartilaginous, rounded, nodular, deep red or grayish tumors occupying some portion of the upper nasopharynx. Their attachment is usually broad, sessile and firm; but in older, slow-growing tumors there may be a freely movable, pedunculated mass. In Figi's series, nasal obstruction was the first symptom most commonly noted. Epistaxis was next most frequent and pain was not a prominent feature. Swelling of the cheek and exophthalmus are mentioned as frequent symptoms by Som and Neffson.[33] Roentgenographic studies in Figi's experience often furnishes considerable information. Lateral views of

the pharynx show the tumor in the nasopharynx to best advantage. In addition, evidence of its extension to the sinuses, orbit or other cranial structures can be obtained. On the basis of their histological structure, Friedberg[34] considers that a better term for these tumors would be "vascular fibroma" or "angiofibroma." They are composed of connective tistue with an unusual number of blood and lymph vessels. The blood vessels are thin-walled, lacking a muscular layer, and are embedded in the fibrous tissue. As the vessels do not collapse when cut, they bleed profusely. Many of the fibroblasts are immature, hence some areas may be suggestive of sarcoma. Fibroma of the nasopharynx must be distinguished from choanal polyps, periosteal fibromas, fibrosarcomas and other types of malignant tumors. Unless there are good reasons for doubting the diagnosis, biopsy is inadvisable because of the possibility of severe hemorrhage. Even though the condition is histologically benign and tends to undergo spontaneous regression, it should be treated because of the dangers consequent on its invasive characterictics. Surgical extirpation is definitely not advisable. Good results are obtained with radium and diathermy coagulation, either separately or combined.

Farmer[35] describes an angioendothelioma as an angiomatous tumor composed of blood vessels in early stages of formation, possessing low grade malignancy. Angiomatous tumors are frequently found but only a small percentage of these can be classified as angioendotheliomas. Cavernous angiomas and angiofibromas are commonly found. The characteristic picture of angioendothelioma is that of blood spaces and vessels in which the endothelial cells tend to grow into the sinuses as small buds. The tumor, although relatively benign, tends to recur when removed, is midly invasive and shows occasional mitotic figures. There are rarely distant metastases. Local excision followed by irradiation should be carried out when possible. A case is reported occuring in a woman, age 27 years, who complained of progressive difficulty in nasal breathing, voice changes and fullness in the ears. A previous attempt to eradicate the tumor had given relief for only a few months. The growth was removed by blunt dissection following which she received Roentgen ray and radium applications. At the time of publication of the article, the patient had remained free from recurrence.

CANCER OF THE NASOPHARYNX.

In a monumental treatise on cancer of the nasopharynx, Martin and Blady[36] discuss literally everything worth considering on that subject. Because this excellent publication is so broad in its scope, it will be used as the basis of this review and the material contained therein will refer to it except where specific mention of some other source is made. Cancer of the nasopharynx occurs most often on the posterior wall, in the region of the pharyngeal tonsil and, next in frequency, on the lateral walls. Occasionally, it may originate lower on the posterior wall; practically never from the anterior wall or the floor.

Incidence: Cancer of the nasopharynx is much more common than reports in the literature indicate. In the past 25 years it has become more readily diagnosed, so that at present at Memorial Hospital it makes up about 2 per cent of all the malignant growths. There can be no doubt that many cases die of metastases while the primary tumor is never diagnosed.

Age and Sex: Cancer of the nasopharynx occurs at an earlier age than any other malignant growth of the upper respiratory and alimentary tracts. One case is reported occurring at the age of 4 years. Hertz,[37] in a study of malignant lesions occurring in the first three decades of life, finds that the prognosis is poorer in patients who are less than 30 years of age. Stinson[38] reports two cases occurring in young brothers. As with other forms of malignant disease of the upper respiratory tract, nasopharyngeal cancer occurs predominantly in the male (about 80 per cent of Martin and Blady's cases).

Racial Incidence and Causative Factors: It is curious that the Chinese are particularly susceptible to this disease and it appears that environment as a suggested cause is not as responsible as true racial heredity. Cloward[39] cites a case occurring in a Chinese boy, age 17 years, whose father died of carcinoma of the stomach. Apparently the causative factors in nasopharyngeal carcinoma are more obscure than cancer elsewhere. The nasopharynx is not subject to the more common forms of chronic irritation, and leucoplakia is never found there. Frequent colds or chronic infection might be considered possible causes, but less than 10 per cent of Martin and Blady's cases were susceptible to these conditions.

Pathology: Because nasopharyngeal cancer originates most frequently in the region of the pharyngeal tonsil, it is natural that highly anaplastic epidermoid carcinomas and lymphosarcomas should make up a large proportion of the cases. Eighty-four per cent of the cases of the series were some form of epidermoid carcinoma, and the majority of these were of the transitional cell variety. Highly differentiated squamous cell carcinomas and spindle cell carcinoma made up a smaller number. The perennial controversy over the inclusion of lymphoepithelioma as a clinical entity is discussed. F. W. Stewart, the pathologist at the Memorial Hospital, leans back to the old designation of lymphosarcoma in reclassifying some of the tumors previously considered lymphoepithelioma of the Schmincke type. He feels that the whole subject of classification is still in an unsatisfactory state and that many pathologists are too ready to make a diagnosis of lymphoepithelioma. Titrud[40] is of the opinion that no distinction should be made between transitional cell carcinoma and lymphoepithelioma and that they should be considered together.

Symptomatology: Characteristically, nasopharyngeal cancer causes few if any symptoms in the early stages. In order of frequency, the first symptoms encountered are cervical metastases, nasal obstruction or discharge, headache or local pain, and defective hearing or pain in the ear. Faier[41] states that widespread cranial nerve involvement, ear and eye complaints may be the presenting symptoms. With regard to involvement of the cranial nerves, they are affected in the following order: VIth, IIIrd, IVth, VIIth and IInd. Involvement of the VIIIth to the XIIth may also occur. Curry and Friedberg[42] mention involvement of the IXth as a cause of dysphagia. Intraocular extension occurs by way of the foramen lacerum, the carotid groove and the superior orbital fissure. This produces exophthalmus, ophthalmoplegia and blindness. In commenting on these symptoms, Hardy[43] states that they are usually not diagnosed until fairly late, or after cervical metastases have occurred. Intracranial extension, while possible as a result of erosion of the floor of the middle fossa, as mentioned by Cantril,[44] occurs probably more often directly through the foramen lacerum. Titrud and Peyton[40] found that in a group of 195 patients, 63 per cent of the cases of squamous carcinoma and 73 per cent of the cases of lym-

phoepithelioma produced neurological complications of some form or other. Druss[45] reports a case with involvement of the petrous apex in which operation on the apex had been performed because of symptoms referable to that structure and in which the primary focus was not found until two months later. Brownell,[46] in reporting two very rare cases of primary carcinoma of the Eustachian tube studied on Furstenberg's service, describes a somewhat similar occurrence in the second of these cases. Simple mastoidectomy, followed later by radical operation, failed to show any indication of petrosal involvement. Autopsy demonstrated extensive involvement of the Eustachian tube, the petrous pyramid, the infratemporal fossa and the Gasserian ganglion.

Diagnosis: Since in about one-half of the cases of cancer of the nasopharynx there are no early symptoms, it is only natural that the diagnosis is so often delayed or not made at all. Other reasons for this delay or failure are the difficulties of examination of the nasopharynx and its general neglect by most physicians. While the nasopharyngoscope permits fairly satisfactory inspection of this area, some portions are not accessible by this method and mirror inspection should supplement it. All suspected cases should have one or more biopsies until the diagnosis is confirmed before intensive treatment is advocated.

Treatment: In general, it may be said that surgical extirpation is not feasible in cancer of the nasopharynx. The primary lesion is inaccessible, very vascular and quick to infiltrate into the cranium; while the cervical metastases which occur in about three-fourths of all cases are often bilateral and widespread and, therefore, not suitable to block dissection. Lierle,[47] however, is of the opinion that if a lesion is well localized and differentiated, surgery alone or combined with radiation may be of value. Irradiation alone appears to be the method of choice. The tumors are extremely radiosensitive and the location will tolerate heavy doses of radiation. The primary lesion is best treated by a combination of external radiation through the cheeks, and intracavitary radiation by radium or radon. During external radiation the orbits, upper lip and tongue should be protected from the effects of the rays and, in order to spare the skin of the cheeks, a part of the external radiation may be given peroorally. Intracavitary radiation with radon in conjunction with

external Roentgen radiation provides adequate dosage without the untoward results produced if either of these agents is used alone. Potozky and Freid[48] report a case of necrotic ulceration of the occipital bone due to radiation of a nasopharyngeal carcinoma, followed by fulminating osteomyelitis with blood stream infection. The old method of applying radium or radon by means of attaching the capsule to a rubber catheter threaded through the nose has been supplanted by a flexible metal rod, to which the capsule is attached by means of a hinge. Accurate placement and immobilization of the applicator in the most advantageous location can thereby be effected. In the case of cervical metastases, it is important to consider both the local and the constitutional effect of large dosages of radiation. Theoretically it may be argued that both sides of the neck should be irradiated through large portals. This is a mistake because if the disease has affected both sides extensively, heroic treatment is usually unavailing and, even if it is successful, the disability from such measures is too great. It is believed that if small portals are used judiciously the tissue dose may be increased to an adequate degree without the production of untoward sequelae. This objective is enhanced by the use of supplementary radium or radon. When widely disseminated metastases occur, radiation will produce distinctly worth while palliation. The local reactions, both in the skin and the mucous membranes, should receive proper attention, and when severe the constitutional reactions of weakness, cachexia, toxicity and weight loss require hospitalization and supportive treatment. Pain can be controlled to some extent by radiation, but care must be exercised in cases of intracranial involvement. Grant[49] believes that if the life expectancy of a patient with cancer is over three months, relief of pain by blocking the sensory supply to the affected area is indicated. The glossopharyngeal nerve supplies sensation to the nasopharynx, Eustachian tube, soft palate, uvula, base of the tongue, and the dorsal wall of the pharynx as far as the epiglottis. The anterior wall of the pharynx is probably also supplied with sensory fibres by this nerve. In some cases where, in addition to a section of the glossopharyngeal, it is necessary to abolish the supply of the upper cervical posterior roots exposure of the medulla is advisable. One who is experienced in neurosurgery will find little difficulty in identifying the vagus and glossopharyngeal. When this has been accomplished, the latter can be readily

severed. If the posterior roots are to be resected, the upper three cervical spines and laminae must be removed, following which the roots can be lifted from the cord, coagulated and cut. The results in a series of 10 cases have very amply justified the procedure.

BIBLIOGRAPHY.

1. Schugt, H. P.: Pyriform Sinus; Anatomic Observations, with Review of Literature. *Arch. Otolaryngol.*, 31:626-644, April, 1940.

2. Burke, B. R.: Anatomic Study of Nasopharynx as Pathway to Infracarotid Portion of Petrous Pyramid. *Ann. Otol., Rhinol. and Laryngol.*, 49:924-938, Dec., 1940.

3. McCarrell, J. D.: Effect of Warm and Cold Nasopharyngeal Irrigation on Cervical Lymph Flow. *Am. Jour. Physiol.*, 128:349-354, Jan., 1940.

4. Hill, F. T.: Diagnostic Pitfalls. *Jour. A. M. A.*, 115:662-665, Aug., 1940.

5. Swinburne, G.: Keratosis. *Jour. Laryngol. and Otol.*, 55:237-250, May, 1940.

6. Novak, F. J., Jr.: Giant Follicular Hypertrophy; Case. *Ann. Otol., Rhinol. and Laryngol.*, 49:526-527, June, 1940.

7. Richards, L. G.: Treatment of Diseases of Throat. *Jour. A. M. A.*, 115:501-506, Aug., 1940.

8. Hughes, *L. W.*: Diseases of Nasopharynx. *Miss. Doctor*, 18:261-264, Oct., 1940.

9. Fox, N. S., and Wigglesworth, A. M.: Cod-Liver Oil in Local Treatment of Pharyngitis. *Med. Bull. Vet. Admin.*, 16:149-151, Oct., 1939.

10. Iglauer, Samuel: Anatomic-Pathologic Studies of Retropharyngeal (Peripharyngeal) Abscess. *Arch. Otolaryngol.*, 33:31, Jan., 1941.

11. Grodinsky, M.: Retropharyngeal and Lateral Pharyngeal Abscesses; Anatomic and Clinical Study. *Ann. Surg.*, 110:177-199, Aug., 1939.

12. Smith, J. E.: Retropharyngeal Abscess with Reference to Abnormally Large Percentage of Adult Cases. *Ann. Otol., Rhinol. and Laryngol.*, 49:490-499, June, 1940.

13. Rhodes, G. K.: Retropharyngeal Infections with Associated Hemorrhages; Rationale of Procedure for Standardized Operations. *S. G. O.*, 70:834-840, April, 1940.

14. Brighton, G. R.: Complications and Treatment. *S. Clin. N. Amer.*, 20:557-565, 1940.

15. Blashki, E. P.: Tonsillectomy-a-Chaud in Quinsy. *Med. Jour. Australia*, 2:936-937, 1940.

16. Youngerman, W. M.: Peritonsillar Edema; Danger of Incision. *Ill. Med. Jour.*, 78:169-171, Aug., 1940.

17. Hall, C.: Sepsis Following Pharyngeal Infections. *Ann. Otol., Rhinol. and Otol.*, 48:905-925, Dec., 1939.

18. Harrington, S. W.: Pulsion Diverticula of Hypopharynx; Review of 41 Cases in Which Operation Was Performed, and Report of Two Cases. *S. G. O.*, 69:364-373, Sept., 1939.

19. Shephard, J. H.: Pharyngoesophageal Diverticula, Modified Technique for One-Stage Operation. *Cal. and West. Med.*, 51:156-159, Sept., 1939.

20. Del Valle, D.:; Yodice A., and Gebauer, P. W.: Diverticulum of Pharyngoesophagus; Two Interesting Cases. *Dis. Chest*, 6:40-44, Feb., 1940.

21. Welin, S.: Deglutition Anomaly Simulating Hypopharyngeal Cancer. *Acta. Radiol.*, 20:452-456, 1939.

22. Shannon, E. H., and Veitch, A. H.: Diseases of Hypopharyngeal Region Producing Dysphagia; Roentgenologic Consideration. *Am. Jour. Roentgenol.*, 42:173-185, Aug., 1939.

23. Morgenstern, David I.: Congenital Atresia of Postnasal Orifices. *Arch. Otolaryngol.*, 31:653-662, April, 1940.

24. Cinelli, A. A.: Nasal Atresias. Surgical Critique. *Ann. Otol., Rhinol. and Laryngol.*, 49:912-923, Dec., 1940.

25. Goodyear, H. M.: Atresia: Description of Operation. *Arch. Otolaryngol.*, 32:522-523, Sept., 1940.

26. Mangiaracina, A.: Congenital Atresia of Posterior Nares. *Arch. Otolaryngol.*, 32:1088-1089, Dec., 1940.

27. Crowe, S. J.: Nasopharynx. *Tran. Am. Laryngol. Assn.*, 62:145-157, 1940.

28. Polvogt, Leroy M.: The Prevention and Treatment of Deafness in Children by Irradiation. *Tran. Am. Laryngol., Rhinol. and Otol. Soc.*, 340-343, 1940.

29. Swinburne, G.: Nasopharyngeal Cyst. *Med. Jour. Australia*, 1:764-766, May, 1939.

30. Putney, F. J., and Fry, K. E.: Retropharyngeal Lipoma. *Ann. Otol., Rhinol. and Laryngol.*, 49:967-972, Dec., 1940.

31. Fox, C. C.: Mixed Tumors of Salivary Gland Type. *Arch. Otolaryngol.*, July, 1939.

32. Figi, F. A.: Fibromas. *Jour. A. M. A.*, 115:665-671, Aug., 1940.

33. Som, M. L., and Neffson, A. H.: Fibromas; Juvenile Cellular Types. *Ann. Otol., Rhinol. and Laryngol.*, 49:211-218, March, 1940.

34. Friedberg, S. A.: Vascular Fibroma. *Arch. Otolaryngol.*, 31:313-326, Feb., 1940.

35. Farmer, W. D.: Angioendothelioma. *Arch. Otol.*, 32:1076-1081, Dec., 1940.

36. Martin, H. E., and Blady, I. V.: Cancer of Nasopharynx. *Arch. Otolaryngol.*, 32:692-727, Oct., 1940.

37. Hertz, C. S.: Malignant Disease of Face, Buccal Cavity, Pharynx and Larynx in First Three Decades of Life. *Proc. Staff Meet., Mayo Clinic*, 15:152-156, March, 1940.

38. Stinson, W. D.: Epidermoid Carcinoma Occurring in Two Young Brothers. *Ann. Otol., Rhinol. and Laryngol.*, 49:536-539, June, 1940.

39. Cloward, R. E.: Nasopharyngeal Cancer. *Arch. Otolaryngol.*, 32:512-516, Sept., 1940.

40. Titrud, L. A., and Peyton, W. T.: Nasopharyngeal Tumors and Their Neurological Complications. *Jour. Nerv. and Ment. Dis.*, 92:727-742, Dec., 1940.

41. Faier, S. Z.: Highly Malignant Tumors. *Neb. Med. Jour.*, 25:297-298, Aug., 1940.

42. Curry, L. T., and Friedberg, S. A.: Diagnosis and Treatment of Malignancies. *S. Clin. N. Amer.*, 20:153-161, Feb., 1940.

43. Hardy, G.: Ocular Symptoms. *Am. Jour. Ophthal.*, 23:446-447, April, 1940.

44. Cantril, S. T.: Malignant Tumors. Problems in Diagnosis. *Northwest Med.*, 39:444-447, Dec., 1940.

45. Druss, J. G.: With Extension to Petrous Pyramid; Case. The Laryngoscope, 50:359-365, April, 1940.

46. Brownell, D. H.: Primary Carcinoma of the Eustachian Tube. *Ann. Otol., Rhinol. and Laryngol.*, 49:551-555, June, 1940.

47. Lierle, D. M.: Epidermoid Carcinoma of Pharynx. *Ann. Otol., Rhinol. and Laryngol.*, 48:875-885, Dec., 1939.

48. Potozky, H., and Freid, J. R.: Osteomyelitis of Occipital Bone Complicating Roentgen Treatment of Nasopharyngeal Lymphosarcoma. *Am. Jour. Roentgenol.*, 43:584-586, April, 1940.

49. Grant, F. C.: Relief of Pain in Cancer of Tongue and Pharynx. *Internat. Clin.*, 1:169-173, March, 1940.

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THE EVALUATION OF THE LABYRINTH FENESTRATION OPERATION FOR CHRONIC PROGRESSIVE DEAFNESS.*

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Interest in the labyrinth fenestration operation among otologists in this country, from the practical standpoint at least, dates back to a time three years ago, when Lempert's[1] work on this subject was presented to this Society. When one considers that for some years prior to this, considerable progressive work was being done abroad, chiefly in the hands of Sourdille[2] and Holmgren,[3] it seems strange that otologists here had not earlier recognized the possibilities of surgical advancement in a field in which all conservative efforts for alleviation had failed and made contributions themselves to the advancement of this work. Within the past three years, this work has been taken up with characteristic American enthusiasm and energy by many otologists and it will soon be made apparent from their accumulated efforts whether the operation as now performed, following the principles laid down by Sourdille,[2] is actually successful, or whether it will require further modifications of surgical technique and the application of further physiological principles, to be learned by experimental research, to give a definitely practical basis for improvement of certain cases of chronic progressive deafness by surgical means.

After three years of surgical efforts in the labyrinth fenestration operation it would seem appropriate for someone to make a critical analysis of the cases operated by the various surgeons and attempt thereby to discover whether or not there is actually a retention of sufficient improvement of hearing in these operated cases to make it a practical surgical procedure. A proper analysis of such cases would also discover many other points of interest, but I believe the one question that is now awaited by a large group of otologists and other

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physicians, many of whom have been skeptical of the value of this procedure, is whether or not the hearing improvement, obtained shortly after the operation, is retained, in a practical amount, to a time when it may be considered permanent. While this appears to be the main consideration in the estimation of the success of the operation it must also be kept in mind that success of the operation may be measured in perhaps an equal quantity on the improvement of the associated tinnitus and the prevention of further progress of the deafness.

In the absence of sufficiently detailed information, particularly serial audiograms of cases before and after operation, as published in the literature, it is not possible at present to make an accurate evaluation of results obtained by the various otologic surgeons as a group. It remains, therefore, for the individual operators to analyze their own cases and present them for consideration. I should like at this time to present such an analysis of my own cases operated in the past three years. In this presentation, I shall discuss particularly the amount of improvement that can be obtained shortly after operation, the amount of improvement that can be retained as an end-result, and shall attempt to show by a study of serial audiograms when the end-result may be reached, as far as the reparative process following the operation is concerned.

In such a study of operated cases many other questions present themselves that could perhaps be discussed with profit. The operative indications would bear further elucidation, particularly on whether or not ears that have been at one time the site of acute infection are suitable for the fenestration operation. In a recent analysis[4] of my first 20 cases which had been operated for more than one year, I presented the end-results in a series of five cases whose operated ears showed by the scars and healed perforations of the tympanic membrane that they had been the site of suppurative infection at one or more times. Of these five patients, two received a gain in hearing of 15 and 17 dcb., respectively as the end-result, while the remaining three lost some hearing over the preoperative level. From the observation of these cases I drew the conclusion that at least some of those patients with scarred and perforated drums could be improved by the operation.

Further observation and study of such cases appears desirable. Another point of discussion could be the consideration of modifications of technique, particularly regarding the removal of the malleus head, the removal of the incus, the methods of fenestrating the labyrinth, and the influence on the end-result of errors in the technique. Interesting information could also be obtained by a study of the audiograms of the unoperated ear. Because of lack of time, little or no consideration can now be given to these issues and I shall discuss chiefly this matter of the amount of hearing improvement that can be obtained and retained, and the estimation of the end-result.

Of my series of 53 fenestration operations performed in the past three years, there are only 23 that have been operated for more than the one-year period that many would select to estimate the end-result. Some of these 23 cannot be used in an evaluation of the hearing improvement, for they have been unsuccessful because of improper operative indications; however, there remains sufficient cases with hearing improvement to gain some information concerning some of the above questions, and in the discussion of some of these problems many of the cases operated for less than a year can be used.

EARLY RESULTS OF THE OPERATION.

When the generally recognized operative indications are present all patients will obtain an immediate improvement of hearing, usually of a considerable degree, at the moment the external semicircular canal has been fenestrated. This hearing is reduced somewhat when the skin flap of the canal wall is placed over the fistula. It is then considerably more reduced when the operated area is firmly packed with paraffin gauze. Usually there is still further reduction of the hearing in another two or three days by the reaction set up in the tissues due to the trauma of the operation. When the gauze packing is removed on the fifth to the seventh day after operation the hearing is usually worse than before operation, due to this tissue reaction.

As this reaction subsides during the subsequent few weeks there is rather rapid improvement of the hearing. There are

several factors that influence the time at which the best postoperative hearing is reached. These can be enumerated as follows: *1.* the rapidity of the subsidence of the tissue reaction (inflammatory swelling and edema); *2.* the amount of trauma sustained by the membranous labyrinth; *3.* the amount of serous labyrinthitis which has been set up; and *4.* the presence or absence of infection in the operated area.

If no infection of the wound occurs, the usual postoperative tissue reaction subsides rather rapidly and the hearing reaches its best point in 10 to 60 days after operation. Of the first 44 of my cases operated, 10 received no improvement of hearing at any time because of unsuitable operative indications. Of the 34 cases that did receive improved hearing, 12 cases obtained the best improvement in less than four weeks after operation, most of these being at the end of the third week. Six of the 34 cases received the best hearing at four to six weeks after operation, and five cases between the sixth and ninth week. One case received the best hearing at three months after operation; another case at 11 weeks; and one case at two years and 10 months after operation. Those two cases that received their best improvement at three months and 11 weeks had infected wounds; however, in other cases in which the wound has become infected, the best improvement has occurred in the three- or four-week postoperative period. In one patient whose severe dizziness for five or six weeks after operation indicated a probable serous labyrinthitis, the best hearing was obtained three weeks after operation. The chief factor in delaying the time of the best hearing appears to be the degree of tissue reaction. In those cases in which the swelling and edema of the drum and skin flap subsided rapidly, the best hearing was present two or three weeks after operation. In those cases in which the inflammation and edema of the drum and skin flap did not subside rapidly and the wound showed a discharge suggestive of infection, the time of the best hearing was delayed for six to nine weeks, and in two instances to 11 and 12 weeks.

The time at which the best hearing is obtained in these operated cases appears to have some connection with the fistula reaction as registered by the stimulation of a cotton applicator. In many of the cases no positive fistula reaction can be produced by the touch of a cotton applicator during

the few weeks or months following the operation. In most of the cases, however, a very active fistula response is registered from immediately after the operation. The negative fistula reaction of some of these cases did not appear to have any influence on the amount of hearing obtained, but did have some effect on the time at which the best hearing appeared. Of those 14 cases of my series which showed improvement of hearing with a negative fistula reaction, the average time for the appearance of the best hearing was 43.5 days after operation. Of 16 other cases which gave improvement with a positive fistula reaction, the best hearing was reached in an average of 31.8 days. The association of the negative fistula with improved hearing has a significance which may be difficult of explanation. I shall briefly speculate on this in a short time.

Through a study of audiograms taken at frequent intervals during the few months subsequent to operation, I have observed in many cases that the best hearing after operation is retained at its highest level only a very short time, sometimes only a few days. As the healing of the tissues progresses, there is a gradual reduction of the hearing from its best level in the great majority of instances. Only a few of my cases have retained the best hearing obtained past the one-year period. In those cases which become failures, the gradual reduction of the hearing from its best level proceeds until all the postoperative improvement has been lost. In some cases the hearing is even further reduced below the preoperative level. In those cases which are successful or partially successful, this gradual reduction of hearing from its best level proceeds only a limited amount. The end-result in these cases is an improvement of hearing over the preoperative level, but a distinct loss from the best hearing obtained.

At this point let us analyze the audiograms of cases to determine, if possible, the average time after operation when this gradual reduction in the hearing postoperatively is completed, and thus arrive at a time when it may be considered that the healing process is complete and the end-result obtained, as far as further reparative processes are concerned.

In arriving at a time when the end-result may be considered attained, the following sequence of events must be accepted as occurring:

1. The reaction of the tissues to the traumatism of the operation causes a reduction of hearing during the first two to four weeks after operation.

2. As the inflammatory swelling and edema of the tissues subside, the hearing gradually improves and reaches its highest level at from 32 to 44 days after operation.

3. When the hearing is at this point it must be assumed that sounds are being conducted through the fistula with a minimum of obstruction, and that the healing process has not advanced sufficiently far to cause any great obstruction to the sound impulses.

4. When the hearing begins to reduce from this highest level, it is logical to believe that the sound impulses are prevented, in a gradually increasing measure, from being conducted through the fistula by the gradual closure of the fistula by the bone regeneration and fibrous tissue formation which is part of the healing reaction.

5. When the gradual loss of the improved hearing stops at a level above the preoperative hearing, it seems reasonable to suppose that the reparative process in the fistula has been completed and that the end-result has been reached as far as the reparative process following the operation is concerned.

Of my series of 53 fenestration operations performed in the past three years, including four revisions, 34 have been operated sufficiently long to be suitable for such an analysis. Some of these, however, have not been under observation at sufficiently close intervals to permit acquiring the necessary information for such a study. Other cases have shown no improvement of hearing at any time after operation and therefore cannot be used. Among my cases there is sufficient information on only 15 operations to make a statistical study. A study of the audiograms of these 15 cases reveals that they all gave a very satisfactory improvement of hearing a few weeks after operation, but subsequently lost some or all of this improvement. However, in following closely this gradual loss of the early improvement, it was discovered that in these 15 cases there was practically no further loss of hearing after the following time intervals from operation: 2 months, 6½ months, 4 months, 2 months, 4½ months, 1 month, 2 months,

4 months, 5 months, 4 months, 4 months, 1½ months, 4 months, 3½ months and 3 months. When these intervals of time are averaged it is found to be 3.4 months. Our analysis of these 15 cases, therefore, shows that after an average time of 3.4 months following operation there is practically no further loss of hearing. If we can assume that the healing process in the fistulized area is complete at the time the ear shows no further loss of hearing, then we can arrive at an approximate time when the end-result is attained as far as the reparative processes are concerned. This figure of 3.4 months after operation to estimate the end-result will be criticized by some on various grounds. Certainly this figure can be considered only approximate and the small number of cases used in the analysis would give a tendency to inaccuracy. The thought can be gained, however, that the end-result may be estimated at some time under a year, and it would seem that if eight months was selected as a basis for determining the end-result of such operations that it would be well within the limits of error.

RESULTS OF OPERATIONS FROM STANDPOINT OF HEARING AND TINNITUS.

To evaluate the result of the fenestration operation from the standpoint of hearing, such factors as the following must be taken into consideration:

1. Sufficient time after operation must have elapsed so that the end-result has been reached as far as the healing reaction is concerned.

2. The operated cases must be separated into two general groups — those with proper operative indications and those having unsuitable operative indications.

3. The cases must be separated again into groups according to the operative technique. That is, all cases operated by a certain technique should be placed in one group, and all those operated by some particular modified technique should be placed in a second group, and so on.

4. The hearing change should be calculated on the basis of average audiometer readings, particularly of the conversational frequencies 512, 1,024 and 2,048.

5. The audiometric averages of the unoperated ear should be taken into consideration.

6. The effect of psychological factors should be evaluated.

7. The subjective reactions of the patient should have consideration.

8. Any estimation of the change in tinnitus will necessarily be based on the subjective sensations of the patient, as there is no way of making a quantitative measurement of tinnitus.

In attempting to evaluate the results in my own series of cases, I shall present figures obtained only from those cases which have been operated for more than eight months. My original thought was to use only those cases which have been operated for more than one year, but in studying the audiograms of all the cases in an attempt to determine when the end-result is reached as far as healing is concerned, I have found, as above stated, that in those cases in which there is a partial loss of hearing improvement obtained after the operation, the reduction of this hearing has reached a stopping point at an average time of 3.4 months after operation. It seems quite likely, therefore, that the end-stage is reached some time before eight months from operation. Those operated cases which possessed the unsuitable indications of poor bone conduction and a dead labyrinth, as well as those cases which had previously had a radical mastoid operation performed, have been placed in the group of improper operative indications, while all others, including those with profound deafness and scarred and perforated drums, were placed in the group of suitable operative indications. Those cases having suitable operative indications have again been placed in two groups — one group containing those cases operated with a modified technique (without removal of the malleus head), and the other group containing those cases operated according to the technique described by Lempert.[1] Any errors of technique that may have influenced the final result will be mentioned.

To obtain a basis of hearing measurement for later comparison, all preoperative audiograms have been averaged and the hearing loss indicated by the average decibel loss of the frequencies 512, 1,024 and 2,048. Any postoperative change

of hearing has been averaged for these same frequencies, and the end-result was an average of the last three audiograms made, except in a few cases where too long an interval separated the last three audiograms. In such cases the last audiogram was used. The change of hearing in the unoperated ear was recorded on the same basis as the operated ear. Certain psychological aspects and subjective reactions of the patient as regards the hearing will be mentioned.

The change of tinnitus was based on the patient's statements regarding this symptom.

My series of cases now show 30 that have been operated for a period longer than eight months. Four of these cases have had revision operations. Although all of these 30 cases have been operated for over eight months, there are five cases on whom it has not been possible to take audiograms this length of time because of their absence from this locality. Two of these patients (Cases 23 and 24) had audiograms up to five months after operations, at which time it was ascertained that they were failures. The remaining three patients (Cases 21, 29 and 30) showed improved hearing at the time of their last audiograms, which was, respectively, 5 months, 3½ months and 4 months. Details of the data on the first 20 of these patients have been reported elsewhere.[4,5] Both the general and operative data on the last 10 of these cases, as well as the previous 20, are herewith presented in tabulated form.

Of these first 30 patients operated, proper indications for the operation were present in 21. Only four of these, however, had normal tympanic membranes. Ten of the remaining 17 showed some degree of thickening and retraction of the membrane of the operated ear, and the tympanic membranes of seven showed scars or healed or unhealed perforations, indicating a suppurative otitis media at one or more times. Four of these 21 having so-called suitable indications had a preoperative loss of hearing of 68 dcb. or more.

The results in these 21 cases having suitable indications were as follows:

1. Thirteen patients received an improvement of hearing of more than 14 dcb. each.

2. The remaining eight patients received either a negligible improvement or a loss over the preoperative hearing.

3. These 13 patients received an average of 21.8 dcb. improvement in hearing.

4. The greatest improvement in any patient was 35.7 dcb. after an interval of 10 months from operation.

5. The second best improvement was 34 dcb. after an interval of two years and 11 months.

6. The eight unsuccessful cases received an average loss of 4.8 dcb. over the preoperative level.

7. The greatest loss in any patient over the preoperative hearing level was 24.4 dcb.

8. Two cases of these eight unsuccessful ones received hearing improvement of 1.5 and 2.6 dcb., respectively.

9. Of the four patients with normal tympanic membranes, two received improvement of 21.3 and 35.7 dcb., respectively, while the other two received no improvement.

10. Of those 10 cases which showed various degrees of thickening of the tympanic membranes, seven received improvement of hearing, and three received no improvement.

11. Of those seven patients whose scarred and perforated tympanic membranes indicated a suppurative otitis media at some previous time, three patients received improvement of 20, 14.7 and 19 dcb., respectively; the remaining four cases lost some hearing over the preoperative level.

12. Those four cases that had profound deafness before operation (over 68 dcb. loss) received 34, 16.6, 25 and 21.3 dcb. of improvement, respectively.

13. Of those eight cases which showed no improvement as the end-result, six showed satisfactory improvement of the hearing shortly after operation. This improvement was lost later during the healing process. Of those two cases that received no improvement at any time, one was improperly operated, and the other had a much distorted and perforated tympanic membrane which had resulted from several attacks of suppurative otitis media.

14. Of those four patients who had revision operations, Cases 3 and 4 received no improvement, Case 8 lost 10 dcb. over the prerevision level, and Case 10 gained 8.3 dcb. over the prerevision level.

15. Of those 13 cases that received improvement of hearing, the fistula reaction at the time of the last audiogram was 3+ in three (Cases 1, 22 and 25), 2+ in seven cases (Cases 6, 8, 11, 12, 17, 21 and 27), 1+ in one (Case 18), and negative in two (Cases 29 and 30).

16. Of those eight cases that receive no improvement of hearing, the fistula reaction at the end-result was 3+ in one (Case 20), 1+ in four (Cases 9, 10, 15 and 16), and negative in three (Cases 3, 4 and 28).

17. In every one of the 13 cases which received improvement of hearing, the tinnitus was either stopped or reduced. The greatest reduction of the tinnitus was in those cases which had the most improvement of hearing. In those cases which lost some of the improvement from the best level, the tinnitus returned to some extent, but in no case in which the hearing remained improved was there a return of the tinnitus to the preoperative state.

18. Among those eight cases that received no improvement of hearing, the tinnitus was improved in only one case. In two of these cases the tinnitus was slightly worse at the end-results.

19. Four of these eight cases that received no improvement of hearing (Cases 9, 10, 15 and 16) were operated with a modified technique (malleus head was not removed). These four received a satisfactory improvement of hearing shortly after operation, but three of them lost all the improvement obtained, and the other one (Case 15) retained only 2.6 dcb. improvement after nearly two years from operation.

20. Of those eight cases that received no improvement of hearing as the end-result, the failures were explained as follows:

a. Four patients (Cases 9, 10, 15 and 16) did not have the malleus head removed. In three of these the skin flap was lacerated also and it was necessary to dissect a skin flap from the anterior superior canal wall to place over the fistula.

b. One patient (Case 3) was improperly operated (fistula was not made sufficiently large).

c. Two patients (Cases 4 and 28) lost their improved hearing because of bone or fibrous tissue closing the fistula.

d. One patient (Case 20) had had several attacks of suppurative otitis media, which probably had impaired the function of the round window.

21. Of those 13 cases that received improvement of hearing as the end-result, errors of technique were made as follows:

a. One patient (Case 1, who received 34 dcb. improvement as the end-result) had the skin flap entirely destroyed and it was necessary to dissect a skin flap from the anterior canal wall to place over the fenestrated external semicircular canal.

b. Two patients (Cases 8 and 29) had the skin flap badly lacerated, but the remnants of it were placed over the fistula.

c. The remaining 10 patients were operated without error of technique.

22. Of those eight cases that became failures, only one (Case 9) received any postoperative complication that may have contributed to the failure. This patient developed a middle ear abscess shortly after operation. Following this, there was a gradual loss of the early improved hearing.

23. Of the 13 cases that were successful, postoperative complications were present as follows:

a. Serous labyrinthitis was present in one patient (Case 6).

b. Slight constriction of the canal was present in two patients (Cases 1 and 27).

c. Infection of the operated area was present in three patients (Cases 11, 27 and 29).

d. Partial temporary facial paralysis developed in one patient (Case 30).

The following are the changes in hearing in those 21 patients having the suitable operative indications, as registered by audiograms:

Case 1 retained 34.3 dcb. improvement 2 years and 11 months after operation.

Case 6 retained 16.6 dcb. improvement 2 years after operation.

Case 8 retained 25 dcb. improvement 1 year and 2 months after operation.

Case 11 retained 20 dcb. improvement 2 years after operation.

Case 12 retained 21.3 dcb. improvement 1 year and 9 months after operation.

Case 17 retained 15 dcb. improvement 1 year and 8 months after operation.

Case 18 retained 14.7 dcb. improvement 1 year and 3 months after operation.

Case 21 retained 20 dcb. improvement 5 months after operation.

Case 22 retained 19 dcb. improvement 1 year and 3 months after operation.

Case 25 retained 22 dcb. improvement 10 months after operation.

Case 27 retained 35.7 dcb. improvement 10 months after operation.

Case 29 retained 26 dcb. improvement 3 months and 3 weeks after operation.

Case 30 retained 14 dcb. improvement 4 months after operation.

Case 3 lost 24.4 dcb. 2 years and 8 months after operation.

Case 4 retained 1.5 dcb. improvement 2 years and 2 months after operation.

Case 9 lost 14.7 dcb. 1 year and 11 months after operation.

Case 10 showed no change of hearing 1 year and 4 months after operation.

Case 15 retained 2.6 dcb. improvement 1 year and 9 months after operation.

Case 16 lost 0.7 dcb. 1 year and 3 months after operation.

Case 20 lost 2.3 dcb. 1 year and 6 months after operation.

Case 28 lost 0.6 dcb. 8 months after operation.

The net results in those 9 cases having unsuitable operative indications were as follows:

1. None of these nine cases retained any improvement of hearing as the end-result.

2. Only one patient (Case 13) received any improvement at any time after operation. This patient showed a gain of 21.7 dcb. one year and three months after the operation, but the final audiogram, one year and 11 months after the operation, showed a gain of only 4 dcb.

3. As the end-result, these nine patients lost an average of 13.2 dcb. of hearing over the preoperative level.

4. The greatest loss in any patient was 30 dcb.

5. The unsuitable operative indication in three of these patients was the fact that they had received a radical mastoid operation at one time. The tympanic membranes and ossicles (malleus and incus) were, therefore, not present.

6. The unsuitable operative indication in the remaining six of these nine cases was considerably impaired bone conduction. Two of these six cases also had impaired labyrinthine function.

7. The fistula reaction (at the end-result) in these nine cases was as follows: 3+ in one case (Case 14), 2+ in four cases (Cases 13, 23, 24 and 26), 1+ in one case (Case 5), and negative in three cases (Cases 2, 7 and 19).

8. The tinnitus was not reduced in any of these nine cases, but was slightly increased in two or three of them.

9. In none of these cases were there any errors in the operative technique that was thought to have contributed to the unsuccessful end-result.

10. Complications developed postoperative as follows:

a. Three patients (Cases 5, 13 and 23) developed infections of the operative area.

b. Two patients (Cases 14 and 26) developed partial temporary facial paralysis.

A preliminary report on nine additional cases which were operated upon three to eight months ago show the following:

Case 31 lost 4 dcb. after 7 months.

Case 32 gained 21 dcb. after 6 months.

Case 33 gained 17 dcb. after 6 months.

Case 34 gained 15 dcb. after 5½ months.

Case 35 gained 30 dcb. after 5 months.

Case 36 gained 30 dcb. after 5½ months.

Case 37 gained 22 dcb. after 4 months.

Case 38 gained 22 dcb. after 3 months.

Case 39 gained 28 dcb. after 3 months.

All these nine cases had suitable operative indications. The present result cannot be considered final as they have not been operated upon for sufficient time. All but one, however, have received substantial improvement of hearing. The one failure (Case 31) received 41.6 dcb. improvement of hearing four weeks after operation, but gradually lost this improvement during the subsequent few weeks. All improvement was lost three and one-half months after operation, and since then there has been no further change.

GENERAL SUMMARY OF RESULTS.

1. Thirty patients have received the labyrinth fenestration operation for periods longer than eight months.

2. Twenty-one of these patients had suitable indications for the operation.

3. Nine patients had unsuitable indications for the operation.

4. Of the 21 patients having suitable operative indications, 13 received an improvement of more than 14 dcb. each at what is considered the end-result as far as the healing process is concerned.

5. These 13 patients received an average of 21.8 dcb. improvement of the hearing. The two best patients received 34 dcb. improvement after two years and 11 months from operation, and 35.7 dcb. improvement 10 months from operation, respectively.

6. The eight unsuccessful cases of the 21 with suitable operative indications received an average loss of 4.8 dcb. over the preoperative level as the end-result.

7. Of those 17 cases which had thickened, retracted scarred and perforated tympanic membrane, 10 received improvement of hearing.

8. Of those eight cases having proper operative indications which showed no improvement as the end-result, six showed satisfactory improvement of hearing shortly after operation, but later lost this improvement because of bony and fibrous tissue closure of the fistula.

9. Those cases which were revised were not successful, two receiving no improvement, one losing 10 dcb., and the fourth gaining only 8.3 dcb.

10. Of the 13 cases that received improvement of hearing, all but two retained a positive fistula reaction.

11. The tinnitus paralleled the change in hearing in all cases. Those that received satisfactory improvement of hearing lost any accompanying tinnitus. In those who lost the improved hearing the tinnitus returned.

12. All of the nine cases (of the 30 operated) who had unsuitable operative indications received no improvement of hearing as the end-result. These patients lost an average of 13.2 dcb. of hearing over the preoperative level.

13. Six of these nine cases which were unsuitable for operation retained a positive fistula reaction without any accompanying improvement of hearing.

14. The tinnitus was not improved in any of these nine unsuitable cases.

15. A preliminary report, which cannot be considered the final result, on nine additional cases which have been operated for over three months shows substantial improvement of hearing in eight, and a slight loss in the remaining patient.

16. The change of the hearing in the unoperated ear has been an interesting phenomenon. Of those 13 patients who received improvement of hearing in the operated ear, nine patients received a slight improvement in the unoperated ear, and four lost a few decibels over the preoperative level. These nine cases gained an average of 3.6 dcb. over the preoperative hearing (in the unoperated ear), and the other four lost an average of 3.5 dcb. At the time when there was the greatest improvement in the operated ear, it was found that seven of the 13 cases received an improvement in the unoperated ear that averaged 6.2 dcb., while two cases lost an average of 3.2 dcb., and four cases showed no change in the level of the unoperated ear.

COMMENT ON RESULTS.

The general and operative data on these first 30 cases are herewith reported so that they may be analyzed in an attempt to determine whether or not the hearing improvement retained in such cases is of sufficient amount to be of practical importance, is in the proper frequencies to be usable, is accomplished in a sufficient percentage of cases to be worth doing, and is sufficiently free of complications and dangerous sequelae to be justifiable. A perusal of the serial audiograms associated with these cases would perhaps allow of more definite conclusions regarding these points, but it seemed impractical to attempt to publish the hundreds of audiograms which were taken to obtain the above data.

In evaluating the results in these cases, let us first consider whether or not the results obtained at this time can be considered final. I have tried to show in the analysis of those cases which lost some of the improved hearing that the gradual loss from the best improvement reaches a stopping point at about three and one-half months after operation. I have assumed from this fact that the gradual loss would have progressed further if the healing reaction which had caused the partial loss had not been completed. I have further assumed, then, that when the gradual loss has ceased, the end-result has been reached as far as the reparative process is concerned. Whether the end-result has been reached as far as further progress of the basic cause of the deafness is concerned is an entirely different matter. My cases have not been operated

upon sufficiently long to determine such a question. I believe we can assume, therefore, that the 13 patients that retained an improvement of hearing beyond the eight months' period from operation will retain this hearing as far as any further changes referable to the operation are concerned.

Has the retained hearing improvement in these cases been of a sufficient amount to be of practical value to the patient? The answer to this question depends almost entirely on the degree of deafness present before the operation was performed. Case 1 was improved from a 68 dcb. loss of hearing before operation to a 34 dcb. loss three years after operation. This has resulted in a tremendous practical advantage to this patient. On the other hand, the 25 dcb. improvement which Case 8 obtained from a preoperative loss of 76 dcb. has given the patient no practical improvement whatsoever, and the patient is dissatisfied with the result. When the preoperative hearing has not been too great, a slight or moderate improvement brings the hearing to a practical level. This is illustrated in Case 30. This patient received only 14 dcb. improvement from a preoperative loss of 42 dcb. Her present hearing level at 28 dcb. loss has been of great practical benefit to her. In these 13 cases which have been improved, there has been a success from the technical standpoint in all of them, but not from the practical point of view. Four of them (Cases 6, 8, 12 and 18) have received no improvement to a practical level because of too severe preoperative deafness. Two of these patients are very dissatisfied with the result, one is much pleased because his tinnitus is reduced, and the other notices some improvement and is partially satisfied. Two other patients (Cases 17 and 22) have improved only to 42 dcb. loss. These two cases, while technically successful, have not been entirely successful from the practical standpoint. They are pleased chiefly at the reduction of the tinnitus but are not enthusiastic. The remaining seven patients have received both technical and practical improvement, and are extremely pleased with the result. Case 27, particularly, has been remarkable, in that she has received 35.7 dcb. improvement from a preoperative loss of 44.6 dcb. This has brought her hearing almost to normal and has entirely stopped the tinnitus in the operated ear. In two or three of these 13 patients that received improvement of hearing in the operated ear, there was also some improvement of

hearing in the unoperated ears, which contributed to the success of the case. In those nine cases which received some improvement in the unoperated ear, however, the average improvement was only 3.6 dcb. over the preoperative level. This finding is in contrast to the observation made by some other operators that the hearing in the unoperated ear is improved to a greater extent in the successful cases.

A study of the serial audiograms of these operated cases shows that any improvement is almost invariably present in the lower and middle frequencies, and practically no improvement at any time is registered in the frequencies 4,096 and 8,192. The results have been shown by the average of the three middle frequencies which are the most important for the understanding of speech, but the improvement for the frequencies 128 and 256 have been just as great as those for the middle frequencies. This is of some importance in estimating the result, because improvement in these two frequencies (especially 256) contributes some to the comfort and benefit which the patient receives.

Is the percentage of success in the operated cases sufficiently high to warrant subjecting a patient to this severe operation? In my own series of 30 patients, the improvement of hearing in only 13 would not be considered a good percentage. However, it must be kept in mind that some of these were operated at a time when definite operative indications had not been established, and it was found, therefore, that a good share of these 30 operated patients were not entirely suitable for operation. It seemed desirable that attempts be made to give improvement in some cases with impaired bone conduction, profound deafness, weakened labyrinthine function and cases having had suppurative otitis media and radical mastoid operations performed. It also seemed desirable to try some cases without removal of the malleus head. Some of these features we now know are antagonistic to a successful result. When those nine cases are eliminated which had either poor bone conduction or had had a radical mastoid operation performed, there are remaining 21 patients with suitable operative indications. Thirteen technical successes of these 21 suitable cases gives a percentage of 62 successes. This percentage was attained in spite of the fact that most of them had such supposedly unfavorable features as thickened, retracted, scarred and perforated tympanic membranes, and

five of them had been operated without removal of the malleus head. A much higher percentage of successes seems to have been attained in those additional nine cases (Cases 31 to 39, inclusive) which had been operated for three to eight months, but which have not been included in the present series because of an insufficient operative interval. These nine cases all had suitable operative indications, and all but one have retained substantial and practical improvement of hearing for three to eight months after operation.

Can it be said that these fenestration operations are sufficiently free of danger and postoperative complications to be justifiable from that standpoint? My opinion would be that the operation is a severe one, but probably no more dangerous than the removal of a chronically diseased appendix. There appears to be practically no surgical shock following the procedure, and if it were not for the dizziness the patient would desire to sit up on the day following the operation. The potential danger of infection is, of course, present but no cases of meningitis have been reported, and it seems doubtful if those very few deaths reported have been actually due to the operation itself. In my own cases, in spite of several infected wounds, there has been no dangerous reaction of any kind in any of the cases. Certain postoperative complications may be of a severe and disagreeable nature. Loss of the vestibular and perhaps the cochlear function may result if the membranous labyrinth is injured. However, this should be extremely rare in a properly performed operation. Infection of the wound has lost much of its potential danger, now that one of the sulfonamide drugs can be used so conveniently in the operated area. Facial paralysis will occasionally occur from the effects of trauma at the time of operation. In three of my patients in which this occurred, beginning a day or two after operation, the facial nerve function was entirely restored in 10 to 20 days after operation. In general, the dangers and complications appear small in proportion to the important results that may be obtained. Certainly, these dangers and complications cannot be as prevalent as in the operation of infected sinuses or mastoids.

GENERAL COMMENTS AND DEDUCTIONS.

The observation of these operated patients has lead to certain deductions regarding various features, including the

operative technique and the results obtained. These are based to some extent on statistical analysis and logical reasoning, but largely on impressions which are not amenable to undisputed proof.

One of these impressions has to do with the amount of hearing that may be obtained and retained by operation. The great majority of my operated cases have not retained the best improvement that was present a few weeks after the operation. I believe that this is the result that will occur and should be expected in the great majority of cases performed by the present technique. Apparently most of the operators performing this work have been fenestrating the external semicircular canals by means of the dental polishing burr. Such an implement slowly wears down the bony capsule through the periosteal, enchondral and endosteal layers to the endosteum. This produces a fine powdery bone dust, which is removed to some extent by either flushing the area with normal saline solution or by wiping it off with a cotton applicator. In order to discourage subsequent bony regeneration it is necessary to remove all particles of bone, including the fine dust from this fenestrated area. If this is done thoroughly by means of the burr and flushing solution, almost invariably there results a laceration of the delicate endosteum lining the bony semicircular canal. To be certain that these particles of bone are entirely removed, it is now the custom of many operators to remove completely the endosteum from the fenestrated area. This results in a dark opening into the lumen of the canal, through which at times can be seen the membranous labyrinth. Through the escape of perilymph fluid from this canal, and through the gentle washing process, the bone dust can be thoroughly removed from the fenestrum and any particles of bone removed by a small hypodermic needle or other fine instrument from the edges of the opening. This procedure should have a favorable effect in preventing bone regeneration as it would leave no bone dust to initiate bony growth. However, it does nothing to prevent regeneration of bone from the periosteal or endosteal layers of the capsule unless it is assumed that the action of the dental burr, either by the heat produced or by filling the Haversian canals with bone dust, retards or prevents bone regeneration from these layers. This does not seem logical and has not been fully substantiated by experimentation.

I believe the removal of the endosteum from the fenestrum contributes materially to closure or partial closure of the opening, rather than tending to prevent it. The removal of all bone dust undoubtedly is of great importance, but the destruction of a section of the endosteum results in the setting up of a healing reaction in this area that is apt to result in closure of the fistula. What is the nature of this endosteum lining the bony semicircular canals? Quoting from Piersol's Anatomy, "The vestibule and the bony semicircular canals are lined by a very thin periosteum composed of a felt-work of resistant fibrous tissue, containing pigmented connective tissue cells. Endothelium everywhere lines the perilymphatic space between the membranous and osseus canals, covering the free inner surface of the periosteum, the fibrous trabeculae, and the outer or perilymphatic surface of this part of the membranous labyrinth." Undoubtedly, when a section of this lining of the canal is destroyed at the fenestrated area, there is an attempt by Nature to repair this damage. Probably there is granulation and fibrous tissue formed within the semicircular canal in this healing attempt and perhaps a regeneration of the periosteum-endothelial lining. Such reactions in this small area would appear to have a bad effect on the membranous labyrinth with the formation of fibrous tissue, adhesive processes, etc. The chief factor, however, that encourages the closure of the fistula, I believe, is the time interval that occurs before this broken endosteum is again restored. While this restoration is going on, there is no tissue for that part of the skin flap that immediately covers the fenestrum to make contact with, and during this time the bone regeneration that takes place from the periosteal and perhaps from the endosteal layers of the bony capsule, proceeds under the skin flap and finally fills in the fenestrum. At the same time granulation tissue and fibrous tissue formation is occurring in that part of the skin flap lying over the fenestrum, and this healing reaction may result in the closure of the opening by dense fibrous tissue.

It seems to me more logical to believe that there is less danger of the fistula closing either by bony or fibrous tissue if the periosteal-endothelial lining of the semicircular canal is not removed or broken during the fenestration process, because then the raw surface of the skin flap deflected from

the auditory canal wall to cover the fistula comes into close contact with the raw surface of the endosteum and makes a primary union before there has been time for bone regeneration to cover this fenestrated area. Bone regeneration is apt to advance, then, for a certain distance from the periosteal layers of the bony capsule, but is not apt to grow through interposing soft tissue any more than a fracture of a bone is not apt to unite if there is soft tissue interposed between the fragments.

From the close observation of my operated cases and in the minute examination of those cases which have been revised, I believe that this is the secret of the retention of the open fistula, rather than the use of any particular kinds of membrane to cover the opening or the use of any particular instrument to fenestrate the canal. If this primary union of the two raw surfaces (the skin flap and endosteum) is the factor in preventing closure of the fistula, then the use of an epithelial surface membrane, such as Shrapnell's membrane, Thiersch graft, conjunctival surface, etc., would tend to encourage closure of the fistula by bony regeneration because the epithelial surface would not be apt to adhere to the endosteum or edges of the fenestrum and therefore would not be interposing a firm tissue between the regenerating bony edges.

In spite of the persistent claims of Lempert that Shrapnell's membrane is deflected to cover over the fistula, it seems definitely assured that in the great majority of cases this is not possible to do. In those cases, then, that have given improved hearing, it is evident that the great majority have improved with a fenestrum covered with the periosteal-lined tympanomeatal flap. I believe that these successful cases are the ones in which this flap has united promptly with the endosteum lining the semicircular canal. In the cases where this endosteum has been removed, it would seem that in the successful cases this broken or destroyed section of endosteum has regenerated and united with the opposing surface overlying the fistula before osteogenesis has proceeded to the point of closing the opening. In those cases which have been only partially successful, that is, in those cases that have lost much of the early improved hearing, this theory would assume that bony regeneration or fibrous tissue formation

had partially closed the fenestrum and left only a small area of contact of the skin flap with the inner lining of the semicircular canal through which sound impulses could penetrate.

I have been led to the advancement of this theory by a close study of several of my early cases, at which time I did not remove the endosteum in the fenestration process. The first patient on whom I performed this operation illustrated the points I have raised. This patient was operated according to the technique described by Lempert, but in dissecting the tympanomeatal flap it was completely destroyed. It was necessary to dissect another skin flap from the anterior canal wall and swing it across the lumen of the auditory canal in order to place it over the fistula. This definitely meant that a raw periosteal surface, instead of an epithelial surface, was placed over the fenestrum. The fistula in the external semicircular canal was made moderately large by means of the polishing burr but as this was the first case I did not wish to take any chances on injuring the membranous labyrinth and, therefore, stopped the fenestrating process when the endosteum became plainly visible. As far as could be seen, there was no break in the endosteum and no perilymph fluid could be detected. This patient has retained the greatest improvement of any of my patients except one. This improvement has amounted to 34 dcb. over the preoperative level after an interval of three years from operation, and his fistula has remained extremely active during this time. His best hearing has been retained and there appears to have been no closure of the fenestrum. This is in contrast to the great majority of the subsequent cases in which the endosteum was removed. The initial hearing has been extremely good, but there has been a subsequent loss of some or all of this improvement coincident with a lessening of the fistula reaction. In the last few cases operated, I have tried to be careful to preserve the endosteum in fenestrating the canal, but to make the fenestrum as large as possible. To preserve the endosteum intact adds considerably to the difficulty in fenestrating the semicircular canal. It is extremely important that all bony spicules and bone dust be removed from contact with the endosteum without breaking this extremely delicate surface. This is difficult to do, but with the aid of magnification and flushing the surface with saline solution it can be accomplished. I

have attempted also in these later cases to make the fistula larger than in the former ones and am also taking greater pains in placing the skin flap over the fenestrum, fitting small pieces of paraffin gauze directly into the fistula depression in order to make firm contact of the two raw surfaces.

After moderate experience with the labyrinth fenestration operation, how can one evaluate the results obtained in general? Certainly it should not be judged by the enthusiastic claims of the earliest reported cases, in which the results were based largely on the early improvement of hearing obtained and on the subjective reactions of the patient; and certainly it should not be condemned by the prejudiced unfairness of those whose little personal experience should not entitle them to judge this work. That there have been brilliant successes cannot be doubted by those having personal touch with such cases. The brilliant successes, however, in which the patient has obtained and retained the desired and anticipated improvement with satisfied subjective reactions are not numerous, but the partial successes in which the patient has retained some of his improved hearing and some practical benefit are common.

Certainly we cannot claim permanent restoration of practical physiologic hearing, as has been done by Lempert,[6] even in the best of our cases. The most we can claim at this time for any patient is the improvement of his hearing to a practical level which appears to be permanent as far as any effects of the operation are concerned. To speak of permanent restoration of hearing assumes entirely too much regarding the prevention of further progress of the basic cause of the deafness. Whether the operation has any beneficial interference with further advancement of the deafness cannot be known without close observation for many years of such operated cases.

The well known nervous instability of deafened individuals is a factor which must be taken into consideration in evaluating the results. In the postoperative care of the operated patient this characteristic evidences itself very forcibly. At the time the patient receives his greatest improvement of hearing (three to five weeks after operation) nothing could be more encouraging or gratifying to the operator than to

note the reaction of the patient. The disposition and personality of the patient frequently makes a remarkable change for the better at this time, and the generally pleased expression and actions of the patient are extremely stimulating. Such moods, however, are constantly changing with the fluctuations of hearing so characteristic of otosclerosis. An example is the patient who has had his hearing improved from a considerable deafness to just above the level of practical hearing. While it is at this point he is pleased, but an emotional or physical disturbance, change of weather, nasal cold, etc., occurs and reduces this hearing temporarily to a level slightly below the practical point and the patient's expression becomes a mixture of anxiety and disappointment. A frequent attitude of the patient is exemplified in many of those cases in which the hearing has been considerably improved at the optimum time after operation, but which has, during the subsequent few months, reduced to a point somewhat below the best result but which could still be considered a good technical result. Such patients are not satisfied with this lesser result once they have experienced for a few weeks the hearing which was present at its best level. This loss of some of the improvement impresses these patients deeply. Some of them look upon the operation as a failure because of this loss. They are not satisfied with perhaps the 20 to 25 dcb. improvement that is retained. They want the 30 to 40 dcb. improvement that was present when the hearing was at its best. This attitude applies particularly to those patients who have had a severe loss of hearing before operation and who have obtained an improvement well above the practical level when at its maximum. When some of this improvement is subsequently lost, so that the end-result is a level slightly below the practical point, such patients are not completely satisfied. The relief of the tinnitus at first followed by a partial recurrence, paralleling the state of the hearing, is also a source of some dissatisfaction in these cases. On the other hand, those patients that obtain a good improvement which is retained at its best level are tremendously pleased and grateful, and compensate in a large measure for the disappointed ones above described.

The reactions of those patients who are dissatisfied or only partly pleased with their improved hearing perhaps suggest

the adherence to the rule of not operating those patients with profound deafness. An improvement of 25 or more decibels can frequently be obtained in such patients, however, and if they were made to realize, before operation, that their hearing could not be improved to a comfortable or practical level, they would, perhaps, not feel that the operation was a complete loss. Considering it from one standpoint, it would appear perfectly justifiable to operate the profoundly deaf patients if it was thought that an improvement of 25 or more decibels could be obtained. Such an improvement would very likely reduce considerably any associated tinnitus and would place the hearing in such a patient at a level that would respond much more favorably to a hearing aid if one were desired, to give further hearing benefit.

How can the operation be judged as far as percentage of successful results are concerned? To determine this requires a definition of the word successful as applied to such cases. If we mean by success the improvement of hearing to the amount of 15 to 25 dcb. over the preoperative level without regard to the amount of preoperative loss or to the changeable psychological factors of the individual patient, then we can say that the operation is successful in a sufficiently high percentage to be a distinct advance in the therapy of chronic deafness. If success is estimated by an improvement of hearing in all cases to a practical level and the satisfying of the changeable moods of deafened patients, then the operation is successful in a considerably less proportion of cases. My own figures of 62 per cent technical successes of 30 operated patients having suitable operative indications are not particularly impressive, but, as stated before, there have been several factors among these which may have contributed to a lower proportion of successes, such as modified technique and the operation of ears having scarred and perforated drums.

The degree of perfection of technique naturally modifies to some extent the percentage of successes and the degree of hearing improvement, but it has been surprising to me to note in several cases how certain errors of technique have not apparently impaired the end-result. This was illustrated particularly in my two best cases. In one it was necessary to cover the fistula with a skin flap dissected from the anterior canal wall because of destruction of the posterior skin flap.

In the other case a particularly narrow fistula was made because of fear of injuring the membranous labyrinth. In this latter case the wound became badly infected and did not become dry and healed until eight months after operation. None of my cases operated without errors have approached these two cases in hearing improvement.

There has been some difference of opinion regarding the advisability of operating those deafened patients who have had attacks of suppurative otitis media at one or more times. Some of these cases, without doubt, have had the function of the round window impaired by fibrotic and adhesive processes and would not be favorable for improvement of hearing by labyrinth fenestration. On the other hand, many such persons are deaf because of interference with the vibratory action of the drum and the conduction of sound through the ossicular chain by the changes induced by the otitis media. Such cases should respond well to the fenestration operation and my experience has produced some favorable results in such cases. As a matter of fact, such patients should be more free of danger of progression of the deafness after operation than the typical otosclerotic cases because in the latter the possibility of further advancement of the deafness by a continuation of the otosclerotic process into the inner ear is always present, while in the former this factor is absent unless there is a coincident otosclerosis.

What impression regarding the technique of the operation can be gained by a moderate experience? My first impression is that the difficulties of the operation have been greatly exaggerated. These difficulties have appeared to many to be greater because of the seeming desirability of doing the operation by Lempert's endaural technique. In my opinion the operation does not require the anatomical knowledge that a radical mastoid operation does. The difficulty is not in the actual surgical work but in the care and patience with which the necessary details must be carried out. In my last six cases I have done the operation through a postauricular incision and find five distinct advantages in this method of approach over the endaural route: *1.* the exposure of the mastoid cortex is obtained in a shorter time; *2.* there is considerably greater ease in doing the bone work, particularly in removing the bone necessary to enlarge the epitympanic

recess and to remove the sulcus tympanicus preparatory to excision of the malleus head; *3.* there is a much better view of the operated area obtained by the assistant, who can thereby help in a more efficient manner. *4.* there is less discomfort to the patient because in the curetting process the counter pressure is on the posterior edge of the excavated mastoid cavity rather than on the soft tissues of the auricle; and *5.* in the healing process there is less tendency to constriction of the upper canal wall since there is no incision in this area. The greatest advantage is the greater ease in using the curette. Ordinarily this is used with a leverage action on the posterior part of the operative area. With the endaural incision this leverage action is on the conchal border and other parts of the auricle, while in the postauricular route the fulcrum is the hard bony edge of the mastoid cortex. By using the postauricular approach, I have been able to shorten the time of the operation by at least half an hour, and with little or none of the restlessness or moaning by the patient that is frequently present with the pressure on the auricle necessary in the endaural route. When it is universally realized that this operation can be done, with certain definite advantages, by the postaural route, I believe it will be done by a much greater number of surgeons who have been somewhat reluctant to use the generally less familiar endaural approach.

CONCLUSIONS.

In the present stage of development of this operative treatment of chronic deafness it is not practical to draw very definite conclusions. Much uncertainty still exists regarding such features as operative indications, accuracy of diagnosis, physiological explanation of the results, desirability of particular techniques and the prognosis of operated cases. My personal experience with the operation, however, has led me to form such impressions regarding several features of this work as follows:

1. The labyrinth fenestration operation, following the principles of Sourdille, gives a definite means of improving the hearing in certain cases of chronic deafness.

2. This improvement is retained to a time when it may be considered permanent, as far as the operative procedure is

concerned and to a degree that is practical, in a sufficiently high percentage of cases to be a practical therapeutic procedure.

3. The end-result should not be considered attained until an interval of four to eight months after operation.

4. In the great majority of successful cases the end-result will not be the best hearing obtained a short time after operation but will be somewhat reduced from this high point, but will remain of practical importance providing the preoperative deafness has not been of too great a degree.

5. Whether or not practical hearing is obtained as an end-result in successful cases depends on the degree of deafness before operation.

6. The postauricular approach gives several important advantages over the endaural route.

7. The retention of the open fistula depends on the union of the opposing soft tissue surfaces at the site of the fistula before bone regeneration has proceeded to the point of closing the fistula. Such interposing of soft tissue between the bony edges should prevent the spread of bone over the fistula. A raw surface of the skin flap, therefore, should be better than an epithelial surface to cover the fistula.

8. Further experimental and clinical research is necessary to clarify the technical and physiologic problems connected with this work in order to give it the greater degree of success desired by all concerned.

SLIDES SHOWN AND DISCUSSED.

I wish to go over this slide hastily. It shows the cases which have been improved for more than six months after operation.

The case numbers are given, the time elapsed since operation is shown and also the average decibel loss for the 512, 1,024 and 2,048 frequencies. In one column is shown the average decibel loss after operation, another column shows the average decibel improvement and another column, the fistula reaction. A 3+ reaction means a very strongly positive fistula reaction, a 2+, a moderate reaction and 1+ a slightly positive reaction.

The first case still remains practically the best one, although there was an error made in the technique. It is now practically three years since operation. Before operation there was a 68 dcb. loss and at present there is a 34 dcb. loss, an improvement of 34 dcb. having been made. The fistula reaction is extremely active.

Case 6 is two years old now. There was profound deafness before operation. There has been a 16½ dcb. gain, but this has given no practical improvement.

Case 8 shows the same thing. There is a 25 dcb. improvement over the preoperative level, but as she was profoundly deaf before operation this improvement has been of no practical benefit and she is dissatisfied with the result.

Case 11 is a satisfactory one, especially as she had a large perforation in the drum before operation. She had had two or three attacks of suppurative otitis media. She has retained, after a two-year period, a 20 dcb. improvement in hearing, with the retention of an active fistula.

Here is a case with 21 dcb. gain of hearing but with no practical improvement. Another case gave a slightly practical improvement with a 15 dcb. gain. The best of all my cases is here shown, with 44 dcb. loss before operation and an improvement to 9 dcb. loss 10 months after operation.

This slide shows the improvement in a series of cases operated three to eight months ago. They are not final results. They show a 20 dcb., 26 dcb., 14 dcb., etc., improvement. Some of them have a negative fistula reaction but, nevertheless, show a substantial gain of hearing.

This slide shows the operation as performed through a postauricular incision. It is better to cut out the concha to some extent so that a larger opening is maintained to facilitate postoperative dressings. A great advantage of this approach is the facility with which the curette can be used. To uncover the epitympanic recess, the hard bone is removed largely with curettes by a leverage action on the posterior part of the mastoid cavity. In the postauricular approach the fulcrum is the posterior edge of the mastoid cortex. In the endaural approach the fulcrum is the soft tissue of the concha and the auricle itself. The former route therefore avoids this pressure and the resultant discomfort and trauma which the endaural route produces.

TABLE 1. SUMMARY OF GENERAL DATA ON CASES RECEIVING LABYRINTH FENESTRATION OPERATION.

Case Age Sex Ear Oper.	First Aud. Oper. On Last Aud.	Familial Deaf- ness	Duration of Deafness In Years	Tin- nitus	Previous Treat- ment	Condi- tion of Drum	Bone Conduc- tion	Condition of Eustachian Tube	Diagnosis
1 35 M. R.	6-18-38 6-29-38 4 -7-41	None	7	++	Inflation. Nasal.	Sl. Thickening.	Impaired; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
2 43 M. R.	7-12-38 7-13-38 7-10-39	?	10	+++	Inflation. Nasal.	Normal.	Impaired; <A. C.	Inflation Normal.	Chronic Mixed Deafness.
3 19 F. R.	2-17-38 7-20-38 3- 7-41	None	4½	++	Inflation. Nasal.	Thickening. Scars.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
4 21 F. R.	8-25-38 8-29-38 12-29-38	Sister deaf since childhood	1	++	Much Nasal. Inflation.	Sl. Thickening.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
5 44 F. R.	9-26-38 9-30-38 2-12-41	None	29	++	Radical Mastoid Opera- tion.	Absent. (Rad. Mast.)	Normal; >A. C. Lat. to Right.	?	Chronic Conductive Deafness.
6 38 F. R.	9-26-38 10-12-38 9-16-40	None	38	+++	Inflation. Nasal.	Sl. Thickening.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
7 14 M. L.	5-11-38 10-19-38 9- 9-40	None	5	++	Inflation. Nasal.	Thickening, Retraction, Scarring.	Impaired; <A. C. Lat. to Right.	Inflation Sl. Ob- structed.	Chronic Catarrhal Deafness.

8 40 F. R.	11-19-38 1-11-39 3-27-40	Father and mother deaf	6	++	Inflation. Nasal. Osteo-pathic.	Sl. Thickening.	Normal; >A. C. Lat. to Right.	Inflation Sl. Ob-structed	Oto-sclerosis.
9 38 F. L.	10-28-38 3-29-39 5-16-41	Sister	15	++	Inflation. Nasal.	Scarring, 2 Healed Perfora-tions.	Normal; >A. C. No Lat.	Inflation Normal.	Chronic Catarrhal Deafness.
9 40 F. R.	10-28-38 2- 6-41 5-16-41	Sister	15	++	Inflation. Nasal.	Scarring. Thickening.	Normal; >A. C. No Lat.	Inflation Normal.	Chronic Catarrhal Deafness.
10 33 F. R.	4- 7-39 5- 5-39 9-16-39	None	5	++	Inflation. Nasal	Sl. Thickening.	Normal; >A. C. Lat. to Right.	Inflation Ob-structed.	Chronic Catarrhal Deafness.
11 23 F. R.	4-13-39 5-12-39 5- 3-41	None	12	++	Inflation. Nasal.	Thickening, Scarred and Perfora-tion.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
12 22 M. L.	5-13-39 5-19-39 2-27-41	None	10	++	Inflation.	Normal.	Impaired(?); <A. C. Lat. to Right.	Inflation Normal.	Chronic Perceptive Deafness
13 43 M. R.	6-12-39 6-14-39 5-10-41	None	5	None	Inflation. Nasal.	Slight Thickening.	Impaired; <A. C. No Lat.	Inflation Normal.	Chronic Catarrhal & Perceptive Deafness(?)
14 27 F. L.	6-12-39 6-21-39 2 -5-41		12	++	Inflation.	Thickening.	Impaired; =A. C. Lat. to Left.	Inflation Normal.	Chronic Perceptive Deafness.

(Continued)

TABLE 1. SUMMARY OF GENERAL DATA ON CASES RECEIVING LABYRINTH FENESTRATION OPERATION (Continued).

Case Age Sex Ear Oper.	First Aud. Oper. On Last Aud.	Familial Deaf- ness	Duration of Deafness In Years	Tin- nitus	Previous Treat- ment	Condi- tion of Drum	Bone Conduc- tion	Condition of Eustachian Tube	Diagnosis
15 27 M. L.	3-28-39 6-23-39 4-26-41	Father	6	++	Inflation. Nasal.	Normal.	Normal; >A. C. Lat. to Left.	Inflation Normal.	Oto- sclerosis.
16 44 M. L.	8-28-37 6-27-39 9- 4-40	None	12	++	Inflation. Nose and Tonsil Oper.	Thickened, Retracted.	Normal; >A. C. Lat. to Left.	Inflation Normal.	Chronic Catarrhal Deafness.
17 26 M. L.	8-23-39 9- 8-39 5- 3-40	Aunt	3	++	Un- known.	Thickened.	Impaired; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
18 37(?) F. L.	9-14-39 9-15-39 12-30-40	Mother	5	None	Inflation. Nasal.	Thickened, Retracted, Scarred.	Normal; >A. C. Lat. to Left.	?	Chronic Catarrhal Deafness.
19 50 M. R.	10-19-39 10-20-39 5- 6-41	None	1 or 2	++	Inflation. Nasal.	Normal.	Impaired; <A. C. Lat. to Left.	Inflation Normal.	Chronic Perceptive Deafness.
20 40 F. L.	11- 7-39 11-10-39 5- 6-41	None	8 or 9	+++	Nose and Throat Oper. Inflation.	Thickened. Retracted.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Chronic Catarrhal Deafness.
21 38(?) F. R.	2- 3-40 2 -5-40 7-11-40	Sister	17	+++	Inflation. Nasal. Vit. B. Prostig.	Thickened.	Normal; >A. C. Lat. to Left	Inflation Normal.	Oto- sclerosis.
22 35(?) F. L.	11-20-39 2- 9-40 5- 2-41	None	20	+++	Inflation. Nasal.	Thickened, Retracted; Healed Perforation.	Normal; >A. C. Lat. to Right.	Inflation Ob- structed.	Chronic Catarrhal Deafness.

23 ? M. R.	4-12-40 4-19-40 9-11-40	?	?	++	Radical Mastoid Oper.	Absent.	Normal; >A. C. Lat. to Right.	?	Chronic Conductive Deafness.
24 19 M. R.	5- 6-40 5- 8-40 10- 1-40	None	5 to 10	?	Radical Mastoid Oper.	Absent.	Normal; >A. C.	?	Chronic Conductive Deafness.
25 42 F. R.	6- 4-40 6-19-40 4-14-41	Brother	17	+++	Inflation. Oper. on Nose & Throat.	Thickened, Retracted.	Normal; >A. C. Lat. to Left.	Inflation Normal.	Chronic Conductive Deafness.
26 42(?) M. R.	6- 5-40 6-26-40 3-25-41	?	20	++	Inflation. Nasal.	Retraction.	Impaired; >A. C. Lat. (?)	Inflation Obstructed.	Chronic Mixed Deafness.
27 25(?) F. L.	6-27-40 7- 3-40 5-10-41	None	3	+	Inflation. Nasal.	Normal.	Normal; >A. C. Lat. to Left.	Inflation Normal.	Otosclerosis (?).
28 32 F. R.	7- 5-40 7- 8-40 3- 6-41	Great-aunt	12	++	Inflation. Nasal.	Normal.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Otosclerosis (?).
29 50 F. L.	7- 5-40 7-10-40 10-30-40	Nephew	15	++	Inflation. Nasal.	Slight Thickening.	Normal; >A. C. Lat. to Left.	Inflation Normal.	Otosclerosis (?).
30 41 F. R.	7-11-40 7-17-40 11- 6-40	Sister	18	None	?	Moderate Thickening.	Normal; >A. C. Lat. to Right.	Inflation Normal.	Otosclerosis (?).

The following abbreviations are used: Oper., operated; Aud., audiogram; >, greater than; <, less than; A. C., air conduction; Sl., slight; + indicates slightly present; ++ indicates moderately severe; +++ indicates severe or marked; Vit. B., vitamin B; Prostig., prostigmine.

TABLE 2. SUMMARY OF OPERATIVE DATA.

Case Age	Technique	Time After Oper.	Aver. Dec. Change	Fistula Reaction	Change of Tinnitus	Operative Indications	Complications	Cause of Failure	Revision Result	Time End-Result Obtained After Oper.
1 35	Complete. Skin Flap Torn.	2 Yrs., 11 Mos.	34. Gain.	+++	Much Improved.	Present Except for Thickened Drum.	Sl. Constriction of Canal.			?
2 43	Complete. Incus Removed. Lab. Destroyed.	1 Yr.	18.3 Loss.	—	Worse.	Poor Bone Conduction.	Loss of Labyrinth Function.	Improper Indications and Errors		?
3 19	Complete. No Errors.	2½ Yrs.	24.4 Loss.	—	No Improvement.	Present Except Scarred Drum.	None.	Closure of Fistula	Failure. Fistula Reclosed.	?
4 21	Complete. No Errors.	2⅓ Yrs.	1.5 Gain.	—	Sl. Improvement.	Present Except Thickening of Drum.	None.	Closure of Fistula	Sl. Improvement 6.8 Dec.	?
5 44	Fen. of Rad. Mastoid.	2 Yrs., 5 Mos.	6. Loss.	+	No Change.	Drum Absent.	Serous Labyrinthitis.			?
6 38	Complete. No Errors.	1 Yr., 11 Mos.	16.6 Gain.	++	Much Improved.	Serous Labyrinthitis.				2 Mos.
7 14	Complete.	2½ Yrs.	29.3 Loss.	—	Sl. Worse.	Dead Labyrinth.	Mem. Lab. Destroyed.	Dead Labyrinth; Perceptive Deaf.		?
8 40	Complete. Skin Flap & Drum Torn.	14¼ Mos. To Revision.	25.2 Gain.	++	Much Improved.	Present.	None.		Loss of 8.4 Dec. Af. 1 Yr.	6½ Mos.

9 38	Malleus Head Not Removed.	2 Yrs.	6.6 Loss.	+	No Change.	Thickened and Scarred Drum Healed Perf.	Middle Ear Abscess.	Improper Indications. Incomp. Oper		2 Mos.
9 40	Complete. No Errors.	3 Mos.	22.3 Gain.	—	Much Improved.	Thickened and Scarred Drum.	None.			?
10 33	Malleus Head Not Removed.	14½ Mos. To Revision.	No Change.	+	Slightly Improved.	Present.	None.	Closure of Fistula. Incomp. Oper	8.2 Dec. Improv. Af. 7 Mos.	4½ Mos.
11 23	Complete No Errors.	2 Yrs.	20. Gain.	++	Much Improved.	Scarred and Perforated Drum.	None.			2 Mos.
12 22	Complete No Errors.	1 Yr., 9 Mos.	21.3 Gain.	++	Entirely Relieved.	Present.	None.			?
13 43	Complete No Errors.	1 Yr., 11 Mos.	4. Gain.	++	None.	Impaired Bone Conduction.	None.	Improper Indications.		?
14 27	Malleus Head Not Removed.	1 Yr., 8 Mos.	15.4 Loss.	+++	Probably Worse.	Impaired Bone Conduction.	Partial Temp. Facial Paral.	Perceptive Deafness.		?
15 27	Malleus Head Not Removed.	1 Yr., 9 Mos.	2.6 Gain.	+	No Change.	Present.	None.	Closure of Fistula.		?
16 44	Malleus Head Not Removed.	1 Yr., 3 Mos.	.7 Loss.	+	No Change.	Present Except Scarred Drum.	None.	Closure of Fistula.		?
17 26	Complete. No Errors.	1 Yr., 8 Mos.	15. Gain.	++	Much Improved.	Present.	None.			5 Mos.

(Continued)

TABLE 2. SUMMARY OF OPERATIVE DATA (Continued).

Case Age	Technique	Time After Oper.	Aver. Dec. Change	Fistula Reaction	Change of Tinnitus	Operative Indications	Complications	Cause of Failure	Revision Result	Time End-Result Obtained After Oper.
18 37	Complete. No Errors.	1 Yr., 3 Mos.	14.7 Gain.	+	None Present Before Operation.	Present Except Scarred Drum.	None.			4 Mos.
19 50	Complete. No Errors.	1 Yr., 1 Mo.	23.7 Loss.	—	Probably Worse.	Much Impaired Bone Conduction.	None.	Perceptive Deafness.		?
20 40	Complete. No Errors.	1 Yr., 6 Mos.	2.3 Loss.	+++	No Change.	Present Except Scarred and Perforated Drum.	Wound Infected.	Improp. Oper. Indications.		?
21 38	Complete. Drum Perforated.	5 Mos.	20. Gain.	++	Much Improved.	Present.	None.			?
22 35	Complete. No Errors.	1 Yr., 3 Mos.	19. Gain.	+++	Much Improved.	Present Except Scars and Healed Perforation.	None.			4 Mos.
23	Fenestr. of Rad. Mast.	5 Mos.	30. Loss.	++	Worse.	Drum Absent.	Wound Infected.	Improp. Oper. Indications.		?
24 19	Fenestr. of Rad. Mast.	5 Mos.	5. Loss.	++	No Change.	Drum Absent.	None.	Improp. Oper. Indic.		?
25 42	Complete. No Errors.	10 Mos.	22. Gain.	+++	Much Improved.	Present.	None.			1½ Mos.

26 42	Complete. No Errors.	9 Mos.	.4 Gain.	++	No Change.	Poor Bone Conduction. Impaired Labyrinth.	Temp. Facial Paralysis.	Improp. Indic. Per. cep. Deaf.		?
27 25	Complete. No Errors.	10 Mos.	35.6 Gain.	++	Entirely Absent.	Present.	Sl. Constric. of Canal and Wound Infect.			5 Mos.
28 32	Complete. No Errors.	8 Mos.,	.6 Loss.	—	No Change.	Present.	Constric. of Canal Wall.	Closure of Fistula.		4 Mos.
29 50	Complete. Skin Flap Lacerated.	3 Mos., 3 Wks.	26. Gain.	—	Much Improved.	Present.	Wound Infected.			?
30 41	Complete. No Errors.	4 Mos.	14. Gain.	—	None Before Operation.	Present.	Temp. Facial Paralysis.			?

The following abbreviations are used: Oper., operation; Aver., average; Dec., decibel; Yr., year; Mo., month; Sl., slight; Lab., labyrinth; Fen., fenestration; minus sign indicates a negative reaction; the plus sign, a mildly positive reaction; the double plus sign, a moderately positive reaction; the triple plus sign, a strongly positive reaction.

TABLE 3. RESULTS OF LABYRINTH FENESTRATION OPERATION AS SHOWN BY AUDIOGRAMS OF OPERATED AND UNOPERATED EARS.

Case Ears Operated	OPERATED EAR Aver. of Pre-oper. Aud. Best Post-operative Hearing Aud. Aver. of Last 3 Audiograms							Aver. Dec. Loss Freq. 512 1024 2048	Time After Operation	UNOPERATED EAR Aver. of Pre-oper. Aud. Aud. Time Best Hear. Oper. Ear Aver. of Last 3 Aud.							Aver. Dec. Loss Freq. 512 1024 2048
	128	256	512	1024	2048	4096	8192			128	256	512	1024	2048	4096	8192	
1.	58	59	67	53	85	88	100	68.3		42	43	55	38	67	82	100	53.3
R.	30	40	20	25	30	100	100	31.6	2 Yrs., 11 Mos.	45	35	45	35	65	80	100	48.3
	32	38	27	23	53	100	100	34.3	2 Yrs., 11 Mos.	47	37	45	35	72	82	100	50.3
2.	30	25	35	45	70	100	100	50.		25	25	35	35	70	85	100	46.6
R.	50	50	65	60	80	100	100	68.3	1 Yr.	30	25	40	40	75	85	100	53.3
	50	50	65	60	80	100	100	68.3	1 Yr.	30	25	40	40	75	85	100	53.3
3.	35	43	50	51	60	70	100	53.3		34	42	55	40	46	75	100	46.5
R.	22	35	52	42	49	100	100	47.6	5 Mos.	53	43	59	41	49	69	100	49.6
	77	70	82	75	77	100	100	77.7	2 Yrs., 8 Mos.	45	50	60	55	65	85	100	57.8
4.	37	46	49	46	28	42	100	41.		45	42	42	40	22	69	100	34.6
R.	56	51	52	48	36	70	100	42.	5 Weeks.	48	45	37	40	18	57	100	31.6
	56	55	54	50	40	70	100	46.3	4 Mos.	42	43	43	40	23	60	100	38.8
4.	56	55	54	50	40	70	100	46.3		42	43	43	40	23	60	100	38.8
Revi-	42	52	44	37	32	53	100	37.6	1 Mo.	50	43	51	33	25	63	100	36.3
sion.	48	48	48	37	33	87	100	39.5	2 Yrs., 2 Mos.	48	45	42	42	20	75	100	34.4
5.	46	46	40	29	28	47	40	32.3		41	42	47	36	23	52	33	35.3
R.	45	46	46	34	26	43	47	35.3	4 Mos.	25	25	41	14	16	54	27	23.6
	50	45	45	35	35	75	45	38.3	2 Yrs., 4 Mos.	45	45	30	15	15	30	25	20.
6.	65	70	85	80	65	77	100	76.6		77	73	76	67	39	67	100	60.6
R.	58	48	47	37	35	72	100	39.6	10 Days.	68	69	82	70	45	75	100	65.6
	65	75	75	60	45	70	100	60.	2 Yrs.	100	85	80	80	50	70	100	70.
7.	58	56	58	65	80	88	100	67.3		37	41	51	60	58	65	100	56.1
L.	100	100	90	90	100	100	100	93.3	1 Yr., 11 Mos.	55	55	50	65	55	65	100	56.6
	100	100	90	90	100	100	100	93.3	1 Yr., 11 Mos.	55	55	50	65	55	65	100	56.6

8.	58	57	73	69	88	100	100	76.6		30	34	40	47	64	78	100	50.3
R.	15	20	32	25	42	85	100	33.3	6 Weeks.	40	49	42	52	64	85	100	52.6
	50	50	60	45	50	100	100	51.6	1 Yr., 2 Mos.	33	35	40	50	68	90	100	52.6
8.	50	50	60	45	50	100	100	51.6		33	35	40	50	68	90	100	52.6
Revi-	15	20	35	25	45	80	100	35.	7 Weeks.	30	35	40	50	70	85	100	53.3
sion.	42	48	62	57	68	100	100	62.3	13 Mos.	47	42	35	57	73	90	100	55.
9.	63	63	53	53	45	55	55	50.3		45	48	43	48	30	38	48	40.3
L.	50	45	45	20	15	35	35	26.6	4 Weeks.	55	50	45	45	25	35	60	38.3
	100	77	73	72	50	50	39	65.	1 Yr., 11 Mos.	100	73	77	67	38	42	52	60.6
9.	100	73	77	67	38	42	52	60.6		100	77	73	72	50	50	39	65.
R.	40	35	35	35	25	30	60	31.6	8 Weeks.	65	65	60	60	45	60	35	55.
	50	43	45	45	25	38	48	38.3	3 Mos.	90	70	60	65	45	62	45	56.6
10.	48	38	45	40	28	43	32	37.6		35	30	35	30	15	38	27	26.6
R.	35	20	15	15	20	50	50	16.6	3 Weeks.	25	25	35	25	15	50	20	25.
	56	50	45	45	23	52	43	37.6	1 Yr., 4 Mos.	30	35	40	30	20	58	28	30.
10.	56	50	45	45	23	52	43	37.6		30	35	40	30	20	58	28	30.
Revi-	60	55	40	15	20	65	55	25.	5 Weeks.	35	40	40	30	15	50	20	28.3
sion.	45	40	38	25	25	75	47	29.3	7 Mos.	40	42	40	30	20	47	27	30.
11.	52	53	50	40	37	52	28	42.3		33	32	33	33	18	28	27	28.
R.	20	25	30	5	10	30	20	15.	1 Mo.	25	40	30	30	15	40	30	25.
	30	25	25	20	22	35	22	22.3	2 Years.	28	23	33	28	20	23	18	27.
12.	65	65	95	100	95	75	100	96.6		20	10	10	15	5	0	5	10.
L.	100	75	75	70	80	70	60	75.	1 Yr., 4 Mos.	20	15	15	10	5	5	15	10.
	100	73	73	73	80	67	83	75.3	1 Yr., 9 Mos.	22	18	18	12	3	5	10	11.
13.	45	65	85	75	60	100	100	73.3		50	55	65	65	40	100	100	56.6
R.	35	50	35	35	85	100	100	51.6	1 Yr., 3 Mos.	55	60	75	70	45	75	100	63.3
	43	53	78	65	65	100	100	69.3	1 Yr., 11 Mos.	45	43	75	63	48	85	100	62.
14.	33	43	68	65	70	100	100	67.6		48	45	60	58	65	85	100	61.
L.	55	55	70	85	85	100	100	80.	9 Days.	45	45	55	60	60	85	100	58.3
	48	73	85	78	87	100	100	83.	1 Yr., 8 Mos.	38	43	58	58	58	85	100	58.

(Continued.)

TABLE 3. RESULTS OF LABYRINTH FENESTRATION OPERATION AS SHOWN BY AUDIOGRAMS OF OPERATED AND UNOPERATED EARS (Continued).

Case / Ears Operated	OPERATED EAR Aver. of Pre-oper. Aud. Best Post-operative Hearing Aud. Aver. of Last 3 Audiograms 128	256	512	1024	2048	4096	8192	Aver. Dec. Loss Freq. 512 1024 2048	Time After Operation	UNOPERATED EAR Aver. of Pre-oper. Aud. Aud. Time Best Hear. Oper. Ear Aver. of Last 3 Aud. 128	256	512	1024	2048	4096	8192	Aver. Dec. Loss Freq. 512 1024 2048
15.	58	35	43	50	38	45	35	43.6		63	60	48	43	30	48	35	40.3
L.	50	45	30	40	30	70	50	33.3	10 Mos.	60	50	40	35	35	55	45	41.6
	63	57	50	40	33	50	52	41.	1 Yr., 9 Mos.	45	37	42	42	32	53	45	38.6
16.	54	50	54	44	51	75	58	49.6		43	45	50	38	33	56	54	40.3
L.	40	35	30	20	25	60	100	25.	1 Mo.	50	45	45	40	35	65	55	40.
	45	45	62	37	52	62	62	50.3	1 Yr., 3 Mos.	43	43	57	42	35	60	52	44.6
17.	82	68	60	63	48	65	100	57.		55	50	48	45	38	70	100	43.6
L.	25	35	20	20	10	75	100	16.6	20 Days.	50	45	50	45	30	70	100	41.6
	48	47	50	43	33	87	100	42.	1 Yr., 8 Mos.	47	47	47	47	33	78	100	42.3
18.	100	75	65	60	65	100	100	63.3		50	45	40	35	35	40	50	36.6
L.	30	35	30	30	20	50	100	26.6	6 Weeks.	45	45	40	30	30	50	45	33.3
	100	68	53	48	45	65	65	48.6	1 Yr., 3 Mos.	43	48	43	28	38	45	45	36.3
19.	40	60	65	50	55	75	100	56.6		25	30	40	20	40	100	100	33.3
R.	100	60	80	70	65	100	100	71.6	6 Mos.	30	25	30	30	35	100	100	31.6
	100	80	88	75	78	100	100	80.3	1 Yr., 1 Mo.	28	30	45	28	48	83	100	40.3
20.	30	35	45	45	45	65	60	45.		45	45	40	45	35	75	100	40.
R.	50	45	35	35	55	70	100	41.6	1 Yr., 1 Mo.	35	35	30	30	35	85	100	31.6
	55	50	43	42	57	75	100	47.3	1 Yrs., 6 Mos.	42	38	35	35	35	87	100	35.
21.	40	40	60	60	65	100	100	61.6		30	35	50	45	45	80	100	46.6
R.	10	15	30	30	45	75	100	35.	3 Mos., 3 Wks.	35	40	45	45	50	80	100	46.6
	20	25	40	30	55	70	100	41.6	5 Mos.	25	30	50	40	40	75	100	43.3
22.	54	61	80	60	45	76	100	61.6		47	50	50	42	43	77	53	45.
L.	30	35	50	40	25	80	100	38.3	6 Weeks.	50	50	45	45	45	75	60	45.
	43	48	65	38	25	70	70	42.6	15 Mos.	45	55	50	42	42	77	52	44.6

23.	53	48	45	40	45	80	40	43.3		45	45	45	40	35	45	45	40.
R.	100	70	70	60	65	80	100	65.	3 Weeks.	45	50	40	45	40	40	45	41.6
	100	80	90	55	75	85	100	73.3	5 Mos.	55	50	50	40	35	40	40	41.6
24.	50	40	45	45	35	30	20	41.6		60	55	50	35	30	50	50	38.3
R.	45	45	50	35	55	80	55	46.6	5 Mos.	65	55	55	45	35	55	45	45.
	45	45	50	35	55	80	55	46.6	5 Mos.	65	55	55	45	35	55	45	45.
25.	38	39	48	48	33	45	39	43.		37	37	43	35	37	35	38	38.3
R.	30	25	30	20	10	40	50	20.	21 Days.	45	35	40	35	40	40	40	38.3
	43	22	25	25	13	30	37	21.	10 Mos.	45	38	47	37	35	43	42	39.6
26.	100	75	80	77	62	77	100	73.		30	33	40	32	13	58	47	28.3
R.	100	70	85	70	60	80	100	71.6	5 Mos.	35	30	35	20	15	45	45	23.3
	100	73	85	70	63	78	100	72.6	9 Mos.	40	35	40	25	15	45	48	26.6
27.	45	38	40	47	47	53	43	44.6		43	33	35	42	50	48	33	42.3
L.	20	20	—5	10	15	35	45	6.6	7 Mos.	50	35	25	35	40	45	25	33.3
	27	18	—3	10	20	42	50	9.	10 Mos.	40	32	30	38	42	48	40	36.6
28.	38	45	60	45	45	63	43	50.		50	50	53	53	48	68	43	51.3
R.	30	25	40	35	20	60	100	31.6	1 Mo.	45	40	50	50	45	65	45	48.3
	62	58	67	45	40	55	50	50.6	8 Mos.	45	48	55	50	48	68	43	51.
29.	68	53	62	53	58	100	72	57.6		63	60	67	57	62	83	87	62.
L.	45	45	25	25	30	55	50	26.6	3 Mos.	100	55	50	45	60	80	60	51.6
	57	40	38	22	35	62	100	31.6	3 Mos., 3 Wks.	72	55	60	48	58	87	58	55.3
30.	43	43	53	38	35	78	100	42.		53	48	53	42	37	77	100	44.
R.	30	15	30	20	30	70	100	26.6	3½ Mos.	50	40	40	30	30	75	100	33.3
	35	17	30	22	32	67	100	28.	4 Mos.	43	37	42	30	28	73	100	33.3

The following abbreviations are used: Aver., average; Pre-oper., preoperation; Aud., audiograms; Dec., decibel; Freq., frequencies; Yr., year; Mo., month; R., right; L., left; Hear., hearing; Oper., operated.

TABLE 4. CASES SHOWING IMPROVEMENT FOR MORE THAN 8 MONTHS AFTER OPERATION.

Case No.	Time Since Oper.	Aver. Dec. Loss Before Oper.	Aver. Dec. Loss After Oper.	Aver. Dec. Improvement	Fistula Reaction
1.	2 Yrs.,11 Mos.	68.3	34.3	34.	+++
6.	2 Yrs.	76.6	60.	16.6	++
8.	1 Yr., 2 Mos.	76.6	51.6	25.	++
11.	2 Yrs.	42.3	22.3	20.	++
12.	1 Yr., 9 Mos.	96.6	75.3	21.3	++
17.	1 Yr., 8 Mos.	57.	42.	15.	++
18.	1 Yr., 3 Mos.	63.3	48.6	14.7	++
22.	1 Yr., 3 Mos.	61.6	42.6	19.	+++
25.	10 Mos.	43.	21.	22.	+++
27.	10 Mos.	44.6	9.	35.6	+
29.	10½ Mos.	57.7	18.3	39.4	—

TABLE 5. CASES SHOWING HEARING IMPROVEMENT FOR 3 TO 8 MONTHS AFTER OPERATION.

Case No.	Time Since Oper.	Aver. Dec. Loss Before Oper.	Aver. Dec. Loss After Oper.	Aver. Dec. Improvement	Fistula Reaction
21.	5 Months.	61.6	41.6	20.	++
30.	4 Months.	42.	28.	14.	—
32.	6 Months.	56.1	35.	21.1	+
33.	6 Months.	50.5	33.3	17.2	+
34.	5½ Months.	56.3	41.6	14.7	—
35.	5 Months.	64.6	31.6	33.	+
36.	3 Months.	63.3	26.6	36.7	+++
37.	4 Months.	77.5	55.	22.5	—
38.	3 Months.	60.5	38.3	22.2	—
39.	3 Months.	47.7	20.	27.7	—

BIBLIOGRAPHY.

1. LEMPERT, J. C.: Improvement of Hearing in Cases of Otosclerosis: A New One-Stage Surgical Technique. *Arch. Otolaryngol.*, 28:42, July, 1938.

2. SOURDILLE, N.: New Technique in the Surgical Treatment of Severe and Progressive Deafness from Otosclerosis. *Bull. N. Y. Acad. Med.*, 3:367, Dec., 1937.

3. HOLMGREN, G.: The Surgery of Otosclerosis. *Ann. Otol., Rhinol. and Laryngol.*, 46:3, March, 1937.

4. CAMPBELL, EDWARD H.: Further Experiences in Fenestration of the Labyrinth in Chronic Progressive Deafness: Report of Cases and an Analysis of Results. *Ann. Otol., Rhinol. and Laryngol.*, 50:182, March, 1941.

5. CAMPBELL, EDWARD H.: Experiences with Fistulization of the Labyrinth in Chronic Progressive Deafness: Report of Cases. *Arch. Otolaryngol.*, 30:689, Nov., 1939.

6. LEMPERT, J. C.: Endaural Fenestration of the External Semicircular Canal for Restoration of Hearing in Cases of Otosclerosis. *Arch. Otolaryngol.*, 31:711, March, 1940.

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SECONDARY NASAL DEFORMITIES FOLLOWING CORRECTION OF CLEFT LIP.

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The labial, facial and nasal developments following the repair of the early cleft lip depend upon the success of primary corrections. An ill-directed procedure will unquestionably and eventually lead to distorted anatomical conditions. The repair of the subsequent deformity need not be primarily cosmetic but may be for physiologic reasons.

It is not within the province of this paper to discuss the correction or the pathological involvement of the parts surrounding the nose. With the nasal distortion there is always some pathology in the upper lip that should be corrected. There may be an excessive thickness, slight notches, ugly scars, poor approximation of the vermilion border. The upper lip may be narrow and long, resulting in the narrowing of the slit of the mouth.

A very common condition is the flatness of the upper lip. This may be caused by a lack of forward projection in the underlying maxilla, or the result from a deficiency of labial tissue. If due to a lack of soft tissue, this is corrected by reconstruction of the lip by flaps. If the osseous foundation is at fault the repair is effected by means of buccal inlay. The appended bibliography describes the pitfalls, prevention and correction of these conditions for those interested.

The nasal deformity is characteristic in this type of case. The tip of the nose is flattened; drooping of the alar rim gives the nares a flaring out effect, making the base of the nares unduly wide. The septum is usually deviated to the uncleft side, because it failed to project forwards, and it later will buckle, causing the columella to become distorted in some cases. This will then cause an obstruction to the inspiratory stream of air, thereby altering the physiology of the nasal hygiene.

The flare of the nose is due to the fact that the ala has been allowed to retain or return to its abnormal association with

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the maxilla, whereas, normally, the labial attachment of the ala is in close relation with the premaxilla and columella. Re-establishment of the natural relation of the ala to the columella is necessary to normal development of the nose. In the primary operation this point is often missed (Blair).

Fig. 1 presents the typical deformity of these cases. The tip of the nose is depressed; there is a drooping of the rim, giving the ala a flaring effect; the base of the nares is abnor-

Fig. 1. Typical deformity following correction of cleft lip.

mally wide and the septum is deviated to the uncleft side. There is an ugly scar in the upper lip with redundant tissue, and the vermilion border is irregular and notched.

The surgical correction of these nasal deformities is not as simple as it appears. The object is to raise the depressed tip in alignment to its fellow on the other side, round out to its normal curve the drooping alar rim and reduce the abnormal width of the base of the nares; furthermore, it is necessary to do a plastic resection of the anterior part of the nasal septum. The scar in the upper lip must be removed and a more graceful curve to the vermilion border is given for a more pleasing effect (see Fig. 2).

The repair of this deformity is done in one stage and under local anesthesia. The columella is separated from the anterior

border of the septum by a vertical incision through its fibrous communication. The mucous membrane and perichondrium is separated from the cartilage of the deviated septum up to and behind this obstruction. The perichondrium and mucous membrane on the other side is left intact. When this is done, pass the sharp blade through the midline of the exposed anterior border of the septum as far back as the obstruction, being careful not to penetrate through the cleft side. The entire

Fig. 2. After correction.

dislocated segment is removed in one piece, leaving enough cartilage on the cleft side for support.

The next procedure is to raise the depressed tip. This is done by making an incision on both sides, parallel with the lower border of the alar cartilage, and then by inserting Joseph's curved knife and separating the entire skin of the tip of the nose on both sides from the underlying attachment to the alar cartilage (see Fig. 3A). A flap of mucous membrane is then reflected back, exposing the angle and lateral crus of the alar cartilages on both sides (see Fig. 3B). It is observed that the flare of the alar rim is due to a marked flattening of the alar angle, and that the drooping of the rim is due to the abnormal horizontal position of the lateral crus rather than the normal, graceful curve. It is further noted

that the medial crus of the alar cartilage is short and raised from the level of the opposite fellow.

The alar cartilage on the cleft side is completely removed by dissection, reinserted and placed in juxtaposition with its opposite fellow in symmetrical relationship. It is then sutured together at the intercrural angles (see Fig. 3C).

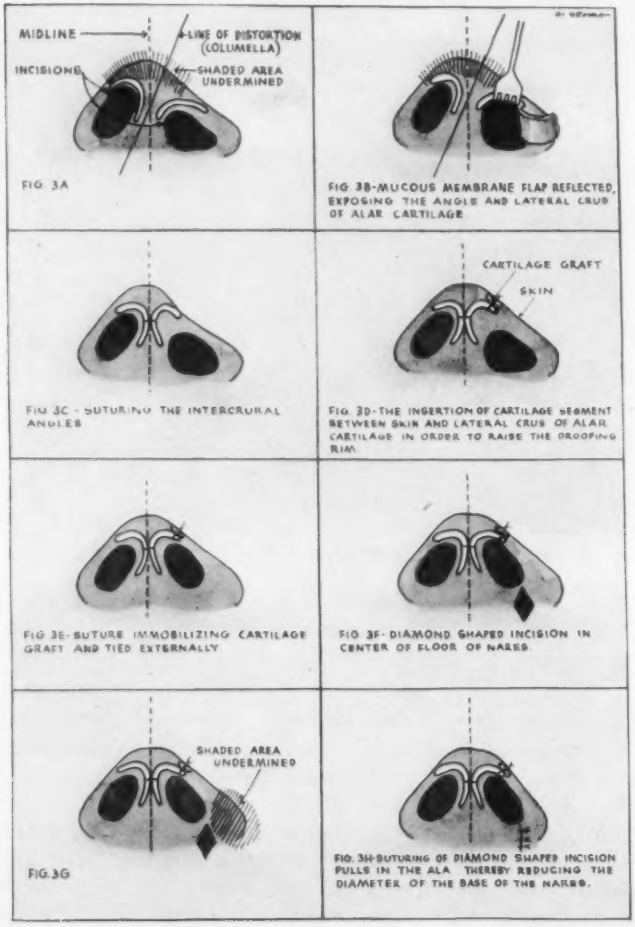

Fig. 3.

The next step is to raise the drooping alar rim and to eliminate its flaring effect. The dislocated cartilage that was removed from the septum in one piece is now utilized to raise the deformity.

This small cartilage graft is trimmed down to the desired shape and size, and the drooping alar rim raised to a symmetrical relationship with its opposite side (see Fig. 3D). The mucous membrane flap is reflected back to its normal position, and one black silk mattress suture is sufficient to immobilize the graft. The suture is tied externally on the skin with a small roll of gauze interposed so as not to cause any undue skin pressure (see Fig. 3E).

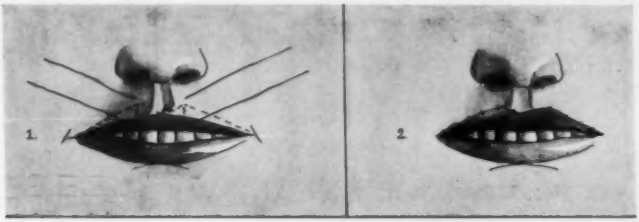

Fig. 4.

Correction of the Wide Base: A diamond-shaped incision is made in the center of the base of the nares and the tissue removed (see Fig. 3F). The ala is separated from its underlying maxilla by deep and wide blunt dissection until the ala can be brought medially to the same symmetrical relation with its opposite fellow (see Fig. 3G). The diamond-shaped incision is then sutured (see Fig. 3H).

The columella is then sutured to the septum with two heavy, black silk interrupted mattress sutures. The scar on the upper lip and redundant tissue is removed.

A new vermilion border is then given to the irregular and notched upper lip. Gillies' classical "cupid bow" operation is indicated for this condition. Make triangular incision as outlined in Fig. 4. Remove all the skin within the incisions. The mucosa is freed around the free border of the lip for some distance from the underlying muscle, and the edge of the mucosal flap is sutured by interrupted sutures to the new skin edge (see Fig. 4). The sutures should be removed on the second day, otherwise suture marks may result.

A common complication in narrowing the abnormal width of the base of the nares in this type of case is in overcorrection, resulting in small nares. This may be due to a number of factors. Should the ala be thickened, the removal of an elliptical segment with its redundant tissue should suffice in narrowing it. It may also be due to a distorted or wide columella and, if so, this should be adjusted accordingly.

It may also be due to the removal of too much tissue in the base of the nares, or too much of a pull on the ala by the subsequent cicatrix. In this event, the deformity is corrected by the insertion of a small flap from the nasolabial region, or the "Seiffert" operation may suffice. The ala is completely severed from its attachment, as in the "Weir" operation. At a distance of 6 mm., an incision is made in the cheek parallel to the exposed area. This flap is then shifted medially and the ala is transfixed with sutures into the new wound area of the cheek.

BIBLIOGRAPHY.

1. Barsky, A. J.: Plastic Surgery. W. B. Saunders Co., Philadelphia. 1938.

2. Blair, V. P.: Nasal Deformities Associated with Congenital Cleft of the Lip. *Jour. A. M. A.*, 84:185, 1925.

3. Brown, G. V.: Nasal Relation of Harelip Operation. *Jour. A. M. A.*, 78:1954, 1921.

4. Brown, G. V.: Surgery of Oral and Facial Diseases and Malformations. Lea and Febiger, Philadelphia. 1939.

5. Davis, W. B.: Harelip and Cleft Palate. Study of 425 Cases. *Ann. Surg.*, 87:536, 1928.

6. Douglas, B.: Aids in Surgery of the Lips. *Ann. Surg.*, 106:293, 1937.

7. Gillies, H. D., and Kilner, T. P.: Harelip Operations for Corrections of Secondary Deformities. *Lancet*, 2:1369, 1932.

8. Humby, G.: The Nostril in Secondary Harelip. *Lancet*, 1:1275, 1938.

9. Kazanjian, V. H.: Plastic Surgery of the Lip. *Jour. A. M. A.*, 77:25:1959, Dec. 17, 1921.

10. Kilner, T. P., and Jackson, T.: Skin Grafting in the Buccal Cavity. *Brit. Jour. Surg.*, 9:22:148, 1921.

11. Moorehead, Fred B.: Correction of Congenital Cleft Palate and Harelip. Surgical Principles Involved. *Jour. A. M. A.*, p. 1951, Dec. 17, 1921.

12. Seiffert, A.: Operative Beseitigung von Perforationen der Nasenscheideward. *Arch. f. Laryngol. u. Rhinol.*, 34:187, 1921.

13. Sheehan, J. E.: Plastic Surgery of the Nose. Paul Hoeber, Inc., New York. 1936.

14. Vaughan, H. L.: Important Factors in the Treatment of Cleft Lip and Cleft Palate. *Ann. Surg.*, 84:223, 1926.

15. Young, F.: The Problems of Unilateral Harelip Repair. *Gyo.*, 65:348, 1937.

1021 Park Avenue.

FOREIGN BODY IN UPPER ESOPHAGUS REQUIRING EXTERNAL ESOPHAGOTOMY.

DR. MERVIN C. MYERSON, New York.

Foreign bodies which lodge in the upper esophagus can usually be removed without much difficulty. Since esophagoscopy became a well established procedure, the impression has existed that anything that goes down can be brought up by means of the esophagoscope. But once in a great while the exception occurs: Something lodges in the upper esophagus which, by virtue of its size, shape, composition, duration of lodgment and the reaction it creates, cannot be dislodged or extracted. A beef bone can be such a foreign body; it is capable of causing severe local reaction, pressure necrosis, anerobic infection, eventual perforation and mediastinitis, unless it is removed before too much damage is done. Given a certain minimal size, once local reaction sets in, such a foreign body may be impossible to remove through the esophagoscope.

A recent experience emphasizes the foregoing remarks. A man, age 32 years, was admitted to the Kings County Hospital on Feb. 9 of this year. While eating goulash two days earlier, he felt a sharp knifelike pain in the lower part of his throat. He choked and turned blue momentarily. That evening he was given an emetic by his family physician, which did not relieve him of the sense of pressure he felt in the lower part of his throat. He had not eaten anything since the time of the accident, although he was able to swallow fluid in small quantities. Swallowing caused severe pain.

At the time of admission the patient's temperature was 100°, his blood pressure, pulse, respiration rate and blood studies were within normal limits. He was a well developed individual, and the only positive finding was marked tenderness on pressure over the left lower neck region.

X-ray and fluoroscopic studies disclosed the presence of a large, semiopaque foreign body — a beef bone — in the esophagus, just below the cricopharyngeus.

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Esophagoscopy was performed on the day of admission by one of my associates. Immediately after, he called to inform me that the foreign body could not be removed with the available instruments. Two hours later, equipped with all necessary instruments, I attempted removal of the bone. It could not be grasped because of the hard, sloping surfaces which presented, nor could the flattest instrument be passed between

Fig. 1. Roentgenogram showing large beef bone in lowermost portion of neck (upper esophagus) with beginning accumulation of gas in the retroesophageal tissues. Note swelling of retropharyngeal and retroesophageal soft structures.

the bone and the esophageal wall. This essential space had been obliterated by the tissue reaction. Esophagoscopy proved futile and was discontinued after 25 minutes.

The next morning the patient could no longer swallow fluids. On Feb. 12, three days after admission, he felt comfortable except for local distress. Esophagoscopy was tried again and failed again. The patient's temperature rose to

103.2°, his discomfort increased and he expectorated a slight amount of blood. Tenderness on pressure was more marked.

An external esophagotomy was performed. Incision was made along the anterior border of the sternomastoid muscle; the tissues were then separated until the esophageal wall, directly behind the lobe of the thyroid gland, was exposed. The wall of the esophagus was greatly thickened; it was incised as far anteriorly as possible. The foreign body, which proved to be part of a vertebral unit, was extracted. A foul odor followed. The mucosa was necrotic, thick and granular; foul seropus was found outside of the esophagus. Its poste-

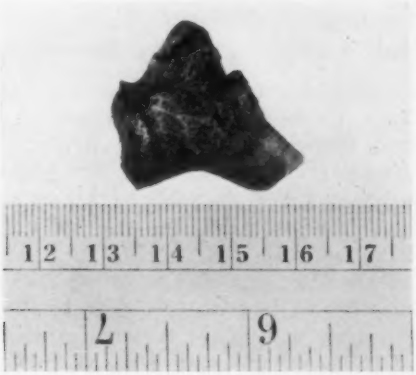

Fig. 2. Photograph of bone a few hours after removal by external esophagotomy.

rior wall was greatly discolored but a perforation could not be seen.

The wound was left open; two wide drains were inserted down to the retroesophageal space. A Levine tube for nasal feeding was passed half way down to the stomach before the esophageal wall was closed by suture. Gentle suction was used to aspirate its foul fluid content. On Feb. 17, five days after operation, the temperature chart indicated the presence of sepsis. At this time the internal jugular vein was found to be thrombosed. It was ligated close to the facial vein above and as far down the neck as possible. The portion between ligatures was removed; it was soft and necrotic. X-ray studies and physical examination failed to reveal evidence of mediastinal infection.

On Feb. 19 he vomited bloody fluid; the same came out of the external wound. His condition seemed worse. Two days later the temperature reached 105°. The patient was drowsy. Bright red blood was expelled from the mouth and the wound. He was, therefore, taken to the operating room, where several small esophageal veins were clamped and ligated. During the next three days his condition remained unchanged.

On Feb. 25 a severe hemorrhage occurred, as a result of which the patient became pale, dehydrated, confused and restless. Numerous transfusions were given at this time, as well as throughout his illness. Two days later, after a gradual decline, he expired.

The blood cultures finally yielded a staphylococcus albus hemolyticus and a nonhemolytic streptococcus.

Autopsy was performed: A large, oblique, gaping wound existed in the left side of the neck, which extended to the retroesophageal space. The wound contained foul-smelling fluid. A perforation of the posterior esophageal wall was found at about the level of the second tracheal ring. A sinus tract led from the perforation to the external wound; another tract led upward to the apex of the right lung; there was still another just below the aorta leading toward the third dorsal vertebra. The anterior jugular vein adjacent to the wound was thrombosed; the wall of the internal carotid artery was thickened and evidenced the same black discoloration as the sinus tracts.

Both pleural cavities were filled with yellowish turbid fluid. A fibrinous exudate covered the surface of both lungs, especially thick at the bases. At the apex of the right lung there was a dirty, blackish gray area which opened into a sinus tract. On section, the lung was boggy and had numerous small abscesses; the surface was blackish brown and necrotic. Most of the parenchyma was still solid. The left lung presented essentially the same changes as the right. Pus could be expressed from both lungs. The primary causes of death were:

1. Gangrenous esophagitis and periesophagitis.
2. Mediastinitis.
3. Multiple abscesses of both lungs.

136 East 64th Street.

BRONCHOSCOPY WITHOUT THE AID OF THE LARYNGOSCOPE.

DR. JOHN MIKELL, Tucson, Ariz.

The purpose of this article is not to discuss bronchoscopy as a diagnostic or therapeutic measure but to put forward to the bronchoscopists the idea of passing the bronchoscope without the aid of the laryngoscope. In a series of approximately 500 bronchoscopic studies, I have found this method most satisfactory. Prior to the bronchoscopy, a most careful inspection of the larynx, pyriform fossae and adnexa should be had. After this, the laryngoscope is discarded and the bronchoscope is passed. The laryngoscope is usually required when using a tube 5 mm. in diameter or less, or when there is a large amount of mucus being expelled through the larynx, blocking the lumen of the bronchoscope. Under these two circumstances, the two instruments are necessary, but in all others I am thoroughly convinced that the use of the laryngoscope in bronchoscopy is entirely unnecessary and makes the procedure more difficult, both to the patient and to the operator.

123 South Stone Street.

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IN MEMORIAM

DR. OTTO JOACHIM,

1863-1941.

Dr. Otto Joachim, of New Orleans, the Nestor of Oto-Laryngology of the South, passed to everlasting rest on Oct. 27, 1941.

Three years ago, his colleagues honored his seventy-fifth birthday with a worthy celebration of the event, and spoke of his splendid character and the high esteem in which he was held by all who enjoyed the privilege of his friendship and skill.

He was born in Palatinate, Germany, and received his early education at Landau. He came to the United States in 1880, graduated in medicine in 1884, and became associated with Touro Infirmary in 1886. He returned to Vienna, Berlin, Heidelberg and Frankfort for postgraduate study in diseases of the ear, nose and throat. Returning to New Orleans in 1888, he began his practice in these specialties and soon was recognized as an eminent authority in this field.

He was the founder of the ear, nose and throat clinics at the Charity Hospital in his city, and was president of the Louisiana League for the Hard-of-Hearing.

During the World War in 1914, while visiting Germany, he volunteered his services in the German hospitals and served there for three months, later being decorated with a medal of honor.

His sterling personality and fine character will be missed by all his colleagues and friends, and his erudite contributions to the literature of his chosen specialty will be an everlasting monument to his memory. M. D. L.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

Meeting of Feb. 14, 1941.

The History of Spectacles. Dr. C. W. Rucker.

Dr. C. W. Rucker, Rochester, gave a talk entitled, "The History of Spectacles." Slides were shown.

Dr. H. J. Rothschild, of St. Paul, followed with these remarks: "Those of you who have visited the old city of Rothenburg, not far from Neurenburg, Germany, probably saw a painted wood carved panel in their town hall showing heads of some old men, one of them with an old pair of spectacles. As I remember it, the spectacles had no temples and were suspended from the bridge of the nose. It immediately attracted my attention because it appeared to be one of the earliest types of spectacles that I had seen portrayed. The guide knew but little of the history of this panel, but said that it dated back to the fifteenth or sixteenth century."

Sulfanilamide in Otitis Media and Mastoiditis. Dr. Henry L. Williams.

Dr. Henry L. Williams, Rochester, read a paper entitled, "Sulfanilamide in Otitis Media and Mastoiditis."

DISCUSSION.

Dr. Lawrence R. Boies, Minneapolis: Dr. Williams' study indicates that the use of the sulfanamides as a treatment for otitis media does not markedly lessen the possibility of a surgical mastoiditis. This contention would seem to be supported by a review of the cases of acute surgical mastoiditis made recently by Dr. Robert Priest at the University Hospital. His study showed that in the past four years, which might be called the "sulfanilamide era," we have had more acute surgical mastoids than in the four years preceding this period; however, the inferences from Dr. Priest's study could be misleading. The average patient coming to the University Hospital is one who, as far as management of an otitis media is concerned, usually has had little medical care. If a sulfanamide has been given, it usually has not been given early in the course of the otitis media and in adequate therapeutic dosage.

It is probable that if we canvassed the opinion of the group at this meeting, the majority would express a belief that the present scarcity of acute surgical mastoiditis is due to the effectiveness of the sulfanamide compounds. It is true that the diseases which cause otitis media are more effectively controlled and it is this fact which for the most part accounts for less surgical mastoiditis.

Dr. Williams' observations are made on a series of cases having careful supervision and checked against a control group. As a result his conclusions undoubtedly represent fact.

It is my belief that in an acute otitis media of a severe type as evidenced by febrile reaction the character and amount of the discharge, etc., sulfanamide therapy should be used in adequate dosage and with the patient in bed. In the average mild case of otitis media this treatment is unnecessary.

I would like to ask Dr. Williams what the effect of the sulfanamides has been on their mortality from otitic sepsis.

In the review I referred to from the University Hospital the mortality has been reduced to approximately 7.5 per cent in this last four-year period in

which the sulfanamides have been used. In the previous four-year period, the mortality approximated 15 per cent.

DR. HORACE NEWHART, Minneapolis: I wish to congratulate Dr. Williams upon the remarkable thoroughness with which he has covered this timely subject. I would like to ask him — what has been his experience in the after-treatment of surgical mastoiditis with respect to the local application of sulfanilamide to the wound to expedite healing?"

DR. ERLING W. HANSEN, Minneapolis: During the use of sulfanilamide when we have cases of acute otitis media do you not have to be more careful in watching the symptoms, for instance, watching the X-ray pictures in regard to destruction that may be masking the use of the drug?

DR. E. J. BORGESON, Minneapolis: Dr. Williams stated he thought the sulfanilamide drugs were of definite value if used early in otitis media. I would like to know what clinical signs indicate the use of that drug, when he decides sulfanilamide should be used and when not to be used.

DR. VIRGIL J. SCHWARTZ, Minneapolis: Our experience at the Minneapolis General Hospital has been somewhat different. We have seen very much less surgical mastoiditis since the advent of sulfanilamide than we did before. Dr. Williams mentioned the work of Dr. Saco with Dr. Platou and Dr. Dwan as among the pioneers in the clinical application of sulphonamide medication in this section of the country. They did a considerable amount of work with sulfanilamide in contagious disease, not only for the prevention of mastoiditis but in the treatment of the upper respiratory inflammation. They gave it, for instance, to their scarlet fever cases *before* any symptoms of otitis appeared, and as a result our incidence of surgical mastoiditis complicating scarlet fever has diminished at least 50 per cent, probably more.

It is evident that we are now witnessing the stage of reaction to the use of these drugs which every new preparation must expect to encounter after its initial widely heralded use and probable abuse. The pendulum is swinging toward the negative extreme, but that it will eventually find its proper point of balance cannot be doubted. One of the first, I think, to call our attention to the fact that this drug was not doing all that was claimed for it was Dr. Pelouze, an urologist. He was beginning to see a number of cases of supposedly cured gonorrhea which were having serious complications. He ascribed this situation to the fact that there probably had been early cessation of discharge and subsidence of acute symptoms in cases of acute gonorrhea, but actually residual and concealed pockets were not becoming manifest until later. He remonstrated against the indiscriminate use of sulfanilamide; nevertheless, we must not become too pessimistic. After all is said, the amount of good it has done is surely far in excess of the harm. We have all seen extraordinary instances of sulphonamide cures in cases which were previously almost 100 per cent fatal. For instance, we saw a case of streptococcus otitic meningitis, with a p.m.n. count of 4,000 in the spinal fluid, which recovered without even a myringotomy. There have been many such recoveries in the past few years, whereas previously they usually went on to exitus.

DR. HENRY WAGENER, Rochester: I do not know how many of you have watched the eyes of your patients who are receiving the various sulfonamide compounds. I was interested particularly in Dr. Williams' statements relative to the effect of these compounds on the blood, and I am wondering whether any of you have noted hemorrhages in the retina associated with these changes in the blood. I am asked to see such patients usually only when a hemorrhage has involved the macular region so that the patient complains of loss of vision. I have seen three or four cases of this type and I have wondered whether hemorrhages may occur in the retina more frequently than we realize if we examine only those patients in whom the involvement of the macula causes a disturbance of vision. Some of you who are doing eyes as well as ear, nose and throat work might have an opportunity to determine how large a percentage of patients do develop hemorrhages in the retina in the course of sulfonamide therapy.

DR. H. L. WILLIAMS, Rochester: I am very interested to learn of the experience at the University Health Service and at the Minnesota General Hospital since the introduction of sulfamido therapy. Personally, I feel that a lessening virulence of infection has had an influence on the incidence of mastoid disease, as does Dr. Boies; however, the fact that a great many patients are receiving sulfamido therapy in acute upper respiratory tract infections before otitis media itself has a chance to develop accounts, I think, for some of the decrease in the incidence of mastoiditis. While our statistics indicate that there is 14 per cent less cases of mastoiditis coming to surgery under sulfamido therapy than under other forms of treatment, the disadvantages of sulfamido therapy, such as supppression of symptoms, toxicity and so forth, more than compensate for this improvement. The greatest advance produced by sulfamido therapy is, of course, reducing the complications from otitis, such as meningitis and septicemia. A year ago I presented our cases of meningitis before this Society, indicating the very definite beneficial effects of sulfamido therapy. In so far as septicemia is concerned, this has almost disappeared from our clinical material.

In reply to Dr. Newhart's question regarding application of sulfanilamide to postoperative wounds, I would say that we have been using sulfapyridine because of the fact that it seems to have a hemostatic effect in addition to the very marked improvement in healing of postoperative wounds produced by it.

I do agree with Dr. Hansen that the sulfamido therapy tends to distort the usual X-ray pictures in mastoid disease. Oftentimes, as he mentions, a destruction will progress in the mastoid in the absence of the usual symptoms of mastoiditis. Another effect which we have noted is that the infection will be turned into the so-called thrombophlebitic mastoiditis described by Beck, in which the septa are not removed by osteoclasts, the disease progressing in the walls of the veins. This seems to me a very dangerous type of mastoiditis as in some cases it reaches and penetrates the dura.

Dr. Borgeson asks what clinical signs indicate use of sulfamido therapy in otitis media. I believe the usual signs of otitis media would be sufficient to indicate the propriety of sulfamido therapy. We feel that in early otitis media we have a good chance of clearing up the infection, particularly if sulfathiazole is used, which we were using during the time in which the patients who form the subject of this present paper were being treated. We feel, however, that unless sulfamido therapy has produced beneficial effects within a week, its use should be terminated. If, however, apparent cure has been secured in this length of time, sulfamido therapy should be continued for the usual 10 days after the disappearance of symptoms.

I am unable to answer Dr. Dittman's question regarding peristalsis as I have not made it a point to inquire as to the presence or absence of this effect.

Dr. Schwartz inquires as to the definition of the use of sulfanilamide, sulfathiazole and sulfapyridine. Sulfathiazole, in the first place, we feel to be a more effective drug in the early stages of otitis media, but we feel that sulfadiazene, more recently introduced, is much better. Of course, sulfathiazole is not effective in meningeal complications or otitis media because of its poor secretion into the cerebrospinal fluid. Sulfanilamide is particularly effective only against hemolytic streptococcus, but it is less toxic than sulfapyridine, and when cultures of hemolytic streptococcus are secured we prefer to use this drug. Sulfapyridine is effective against a wider range of organisms but has the disadvantage of irregular absorption and marked acetylanization, with the poor solubility of the acetylated product tending to produce disposition of the acetylated derivative in the tubules and clices of the kidneys; however, sulfapyridine is the drug of choice particularly in pneumococcal infections. We feel that recently introduced sulfadiazene may be more effective in meningeal complications than sulfapyridine because it is slowly secreted, very little acetylated and passes easily into the spinal fluid.

I have no comment to make in regard to Dr. Wagener's remarks as he serves as my eyes in so far as ocular complications of otitis and sulfamido therapy are concerned.

After reviewing the literature on the mode of action of sulfamido therapy and the results secured elsewhere in otitis media and mastoiditis, more than 200 cases of otitis media and mastoiditis were studied, in which about one-half received sulfamido therapy; the rest acted as controls. It was found that where sulfamido therapy was used without particular regard to adequacy of dosage that 14 per cent came to mastoidectomy. Where attention was paid to adequate dosage, 19 per cent less patients came to surgery than those patients in whom sulfamido therapy was not used. Some instances of toxic effect of sulfamido therapy were pointed out and it was thought that because of the minor improvement produced in acute otitis media and mastoiditis by sulfamido therapy that this drug would be better reserved for the more serious complications of otitis media and mastoiditis, such as meningitis and septicemia.

Fibroma of Nasal Pharynx. Dr. John J. Hochfilzer.

Dr. John J. Hochfilzer, St. Paul, reported a case of "Fibroma of Nasal Pharynx."

This boy, now age 15 years, encountered difficulties in nasal breathing in the beginning of 1939. For that reason an adenoidectomy was performed by his family physician. This failed to relieve the condition and soon after he noticed difficulty in swallowing food — he lost about 30 pounds. He was then seen by Dr. Levin, who made the diagnosis of a nasopharyngeal tumor. (Several attempts to remove the tumor were made.)

He was seen and admitted to Ancker Hospital in April, 1940; a diagnosis of fibroma of nasopharynx was made. Examination at the time revealed a large tumor completely filling the postnasal space, pushing forward the soft palate and extending through the choanae into the right nasal cavity; the surface was smooth, mucous membrane pale in appearance.

On April 4, 1940, three 10 mg. radium needles were implanted into the tumor (1,000 mg. hours of radium given). The left portion of the tumor sloughed off but did not reduce size of right side.

On July 7, again three 10 mg. radium were inserted but, unfortunately, two needles fell out, so he received only 210 mg. hours. The size of the tumor was very little influenced by this application.

The third application of radium was given Nov. 24. He received 1,140 mg. hours. It destroyed pretty well that portion of the tumor which was protruding into right nasal cavity but helped little in the pharyngeal portion. Another much larger radium dose will be given tomorrow, hoping to get a better result.

It is the consensus of opinion that radium is the best treatment of these tumors, sometimes supplemented by electrocoagulation. But any surgical procedure is dangerous on account of the extreme vascularity of these tumors; fatal hemorrhages have been reported, especially in those cases where the character of the tumor was not recognized and surgical removal attempted. Usually it takes several years to remove these tumors — at the Mayo Clinic th patients treated exclusively with radium received an average of six applications. Spontaneous regression of these tumors may occur after patient is from 20 to 25 years of age. Although these tumors are not malignant from an histopathological point of view, they are potentially malignant from a clinical aspect on account of their tendency to extend into vital portions of the skull.

DISCUSSION.

DR. BERT G. LEVIN, St. Paul: When this patient first came in, he was in very bad shape physically. He had not been able to eat — his breathing was very badly interfered with. I took a large section for biopsy, large enough to relieve his obstructive symptoms. He bled very severely — bleeding was almost impossible to control, and transfusions were required. I referred him to Ancker Hospital for radium therapy.

Radical Mastoidectomy. Dr. Henry L. Williams.

Dr. Henry L. Williams, Rochester, showed colored motion pictures on "Radical Mastoidectomy."

NEW YORK ACADEMY OF MEDICINE.

SECTION ON OTOLARYNGOLOGY.

Regular Meeting of Feb. 19, 1941.

a. Nonsurgical Treatments for Deafness:

1. Psychotherapy, Prostigmin, Radiotherapy. Dr. Edmund P. Fowler, Jr.

(To be published in a subsequent issue of THE LARYNGOSCOPE.*)*

2. Drugs, Vitamins, Endocrines, Prostheses, Lip-Reading and Hearing Aids. Dr. William J. Greenfield.

(To be published in a subsequent issue of THE LARYNGOSCOPE.*)*

b. The Consequences of Shortened Intermaxillary Distance. H. R. Juneman, D.D.S.

(To be published in a subsequent issue of THE LARYNGOSCOPE.*)*

c. What Is Being Done for the Deafness of School Children. Dr. Westley M. Hunt.

(To be published in a subsequent issue of THE LARYNGOSCOPE.*)*

d. Incidence of Surgical Procedure, Using Acute Mastoiditis as an Indicator.

A Study Over a Period of 11 Years, with Detailed Statistics for New York and Other Geographic Sections of the United States. Dr. Harold W. Corya.

(To be published in abstract in a subsequent issue of THE LARYNGOSCOPE.*)*

DISCUSSION.

DR. MARVIN F. JONES: Dr. Corya has been working on this paper for about three years; he saw certain indications last year and is very anxious to find out how it will turn out this year. As far as anyone can tell, things are going along on just about the same basis except for unusual and unexpected epidemics, and routine surgery, of which surgery of acute mastoiditis is an indicator, is definitely — and we can state that very positively now — in a permanent slump. This leaves a pretty sad lump in our throats, but it may start ear, nose and throat men thinking. There are rapid changes taking place all over the world, and the test of a man's ability and brain power is whether he is capable of meeting those changes. We have a change taking place in our particular field; I don't think there is any doubt about it. It is now up to us to figure: surgery has had its day, but there are still fields to be explored; there is still, I hope, the intelligence to explore them. Perhaps it is a good thing that we are awakened by a situation like this, not in the future, but already with us, to make us get busy and find where we are going to land.

Biochemistry, foods, preventive medicine — it is along these lines that the ear, nose and throat specialist is going to advance. There are many fields collateral to ours about which the ear, nose and throat man should be informed, to be able to give adequate care to a patient.

DR. WILLIAM H. BEST (Deputy Commissioner, Department of Health, New York): One would expect some relationship between surgical otological conditions and the incidence of communicable conditions involving the nasopharyngeal area. The most important of these are scarlet fever, measles, diphtheria and upper respiratory infections. There are other factors besides the incidence which play a considerable part in the sum total of complications; that is, the severity of the disease, which may be influenced by the virulency of the infecting organisms on the one hand, or the immunity of the population on the other

hand, or a combination of both; and, third, the treatment and management of the case. In other words, it is the interplay of these three factors, which may vary over the long range or vary from year to year that determines the complications.

I wonder whether the extensive survey of mastoid operations made by Dr. Corya can be taken as a complete index of the relationship of surgical otological conditions and communicable diseases. The hospitals canvassed are for the most part noncontagious disease institutions and hence would not get, with few exceptions, the cases of otological complications during the isolation period of the disease. In New York, the period of isolation for scarlet fever is 21 days and thereafter until complications cease, hence a middle ear condition developing a mastoid would, in most instances, go to a contagious disease hospital. The same would be true in measles if the surgical otological condition developed within the isolation period of disease, which is five days from the onset of the rash. May it not be that during a year of high incidence of contagious diseases many cases with surgical complications would be admitted to contagious disease hospitals rather than to general hospitals? Therefore, the surgical otological conditions admitted to contagious disease hospitals might be a truer index of the relationship between these conditions and communicable diseases.

While there has not been any material change in the prevalence of scarlet fever in the past quarter century, there has been a great change in the severity of the disease.

The incidence of measles has not materially changed in the past 25 years. We continue to average about 45,000 cases every two years, an alternating with high and low cycle. Here, again, we find a decrease in the case fatality rate. In 1920 the case fatality rate was 2.10; in 1930, 0.65, and in 1940, 0.29.

Whether this indicates a lesser severity of the disease or better management and care, I do not know. I am inclined to believe it is better management and care. Of course, deaths from measles are due to the complications.

Diphtheria has practically become a nonentity in the past five years. In 1940 we had only 387 cases with 10 deaths. Even here, in these few cases the case fatality rate has been markedly reduced.

Respiratory infections as such are not reportable; however, I believe that reported cases of influenza, which is a reportable disease, may be taken as an index to the prevalence of respiratory infections.

TABULATION OF INFLUENZA — NOV. 1 TO MAY 1.

1930-1931	4,375	1935-1936	769
1931-1932	2,353	1936-1937	4,518
1932-1933	3,224	1937-1938	357
1933-1934	531	1938-1939	1,425
1934-1935	779	1939-1940	558
1940-1941 (to Feb. 15)	2,272		

Respiratory infections vary in virulence from year to year and while complications such as pneumonia, ear and mastoid conditions vary with the incidence, they also vary with the virulence.

Treatment and Management: In the acute contagious diseases and acute respiratory infections, irrespective of incidence or severity, I believe complications can be reduced by the proper management of the case. No matter how mild the disease may be, the patient should be kept in bed during the acute stage or, better, for 48 hours after the temperature has reached and remained normal, or longer if there is any evidence of complication such as albuminuria, adenitis, congestion of the eardrum.

I believe that, as far as New York is concerned, the more general use of convalescent serum and whole blood as a preventive in measles (even when administered too late to do more than modify the disease) and the use of convalescent and antitoxic sera in scarlet fever, together with better management and care of the case during the acute and convalescent stages has been instrumental in reducing the surgical otological complications in these diseases.

BOOK REVIEW.

Orbital Tumors. Results Following the Transcranial Operative Attack. By Walter E. Dandy, Adjunct Professor of Neurological Surgery, Johns Hopkins University. New York, Oskar Piest, 1941. Price $5.00.

This monograph consists of 168 pages and 56 references. The preface is by Alan C. Woods. There are 100 illustrations in black and white. Some of these have subdivisions and subtitles. All are well done. There are eight chapters as follows:

I. Miscellaneous Tumors of the Orbit.

II. Cases of Schüller-Christian's Disease.

III. Dural Tumors of the Orbit.

IV. Carcinoma of the Orbit.

V. Brief Summary of Seven Additional Nonoperative Cases.

VI. Summary. Pathological Study of All Cases.

VII. The Operative Procedure.

VIII. Conclusion.

Bibliography.

The author reports 29 cases with complete illustrations, Roentgen-ray films, operative procedures, progress and final results. Quite naturally the seventh chapter on the operative procedure is very important to the surgeon. The smaller size of the cranial exposure made possible by avertin anesthesia in place of ether is a great improvement. The concealed incision, a bone flap which misses the frontal sinus, evacuation of the chiasmatis cisterna to reduce the volume of the intracranial contents, avoidance of the ethmoidal cells, etc., are all refinements in technique. There was only one death in the series. The advantage of this operation over the older Krönlein operation is very evident. The author gives other surgeons credit for their work, such as Adson and Benedict, Hoover and Horrax.

The monograph is excellent and is in keeping with the skill and ingenuity of its author. F. R. S.

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Secretary: Dr. Paul Holinger, 1150 N. State Street, Chicago.
Place: Atlantic City, June 8-9, 1942.

American Laryngological Association.

President: Dr. T. E. Carmody, 227 16th Street, Denver.
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Southern—Chairman: Dr. William L. McDougall, 915 Doctors' Building, Atlanta. Jan. 23, 1942.
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